Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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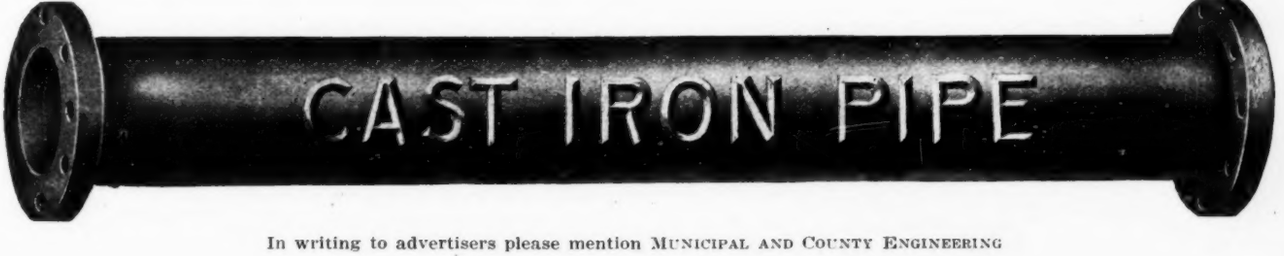

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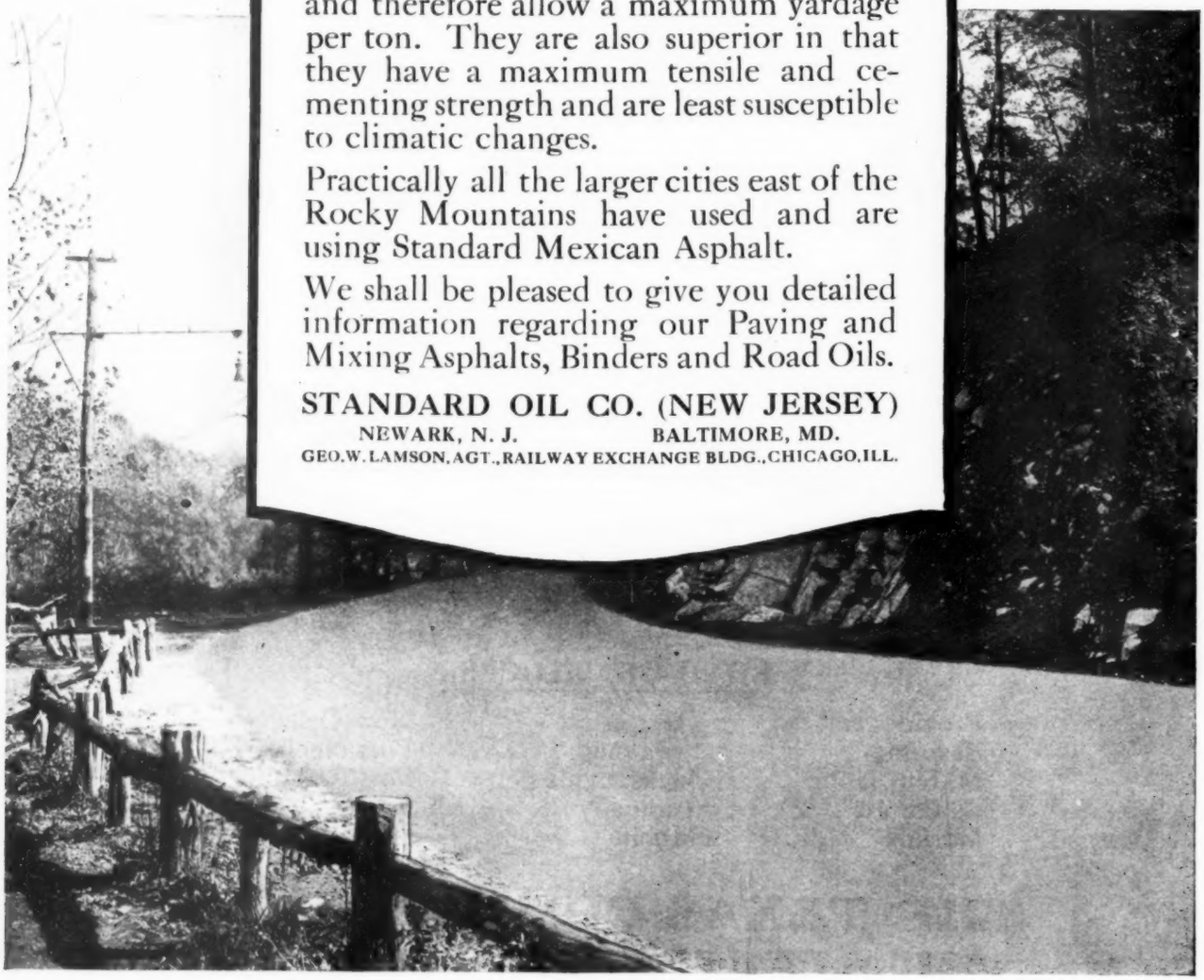

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Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

From an unretouched photograph

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This photograph was not posed for advertising—it shows the actual condition of a seventeen-mile link of so-called road between Pittsburgh and Butler, Pa.

Use your influence for good roads at every opportunity. Good roads are one of the greatest agencies in advancing the economic and social life of the nation.

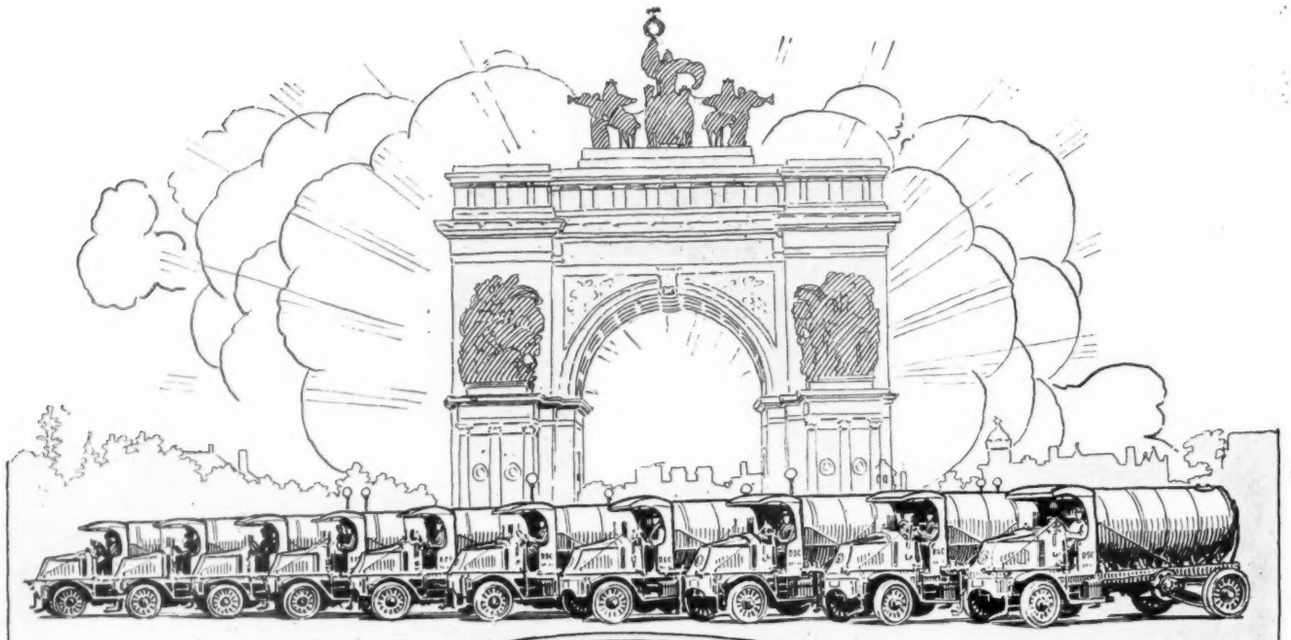
The Highway Industries Association, 1311 G Street, N. W., Washington, D. C., has done so much toward forwarding good roads that we suggest you ask how they can help you to improve road conditions in your community.

Chassis $2050

THE AUTOCAR COMPANY, Ardmore, Pa.
Established 1897
Factory Branches and Dealers in the Principal Cities

Autocar

Printed as insert to Municipal and County Engineering, May, 1919.



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Equipped with every improvement and convenience to facilitate the work and eliminate hand labor, MACK Trucks get street cleaning costs down to bedrock.

From 1 to 7½ tons—trailers to 15 tons. Special bodies for every need.

Write for information.

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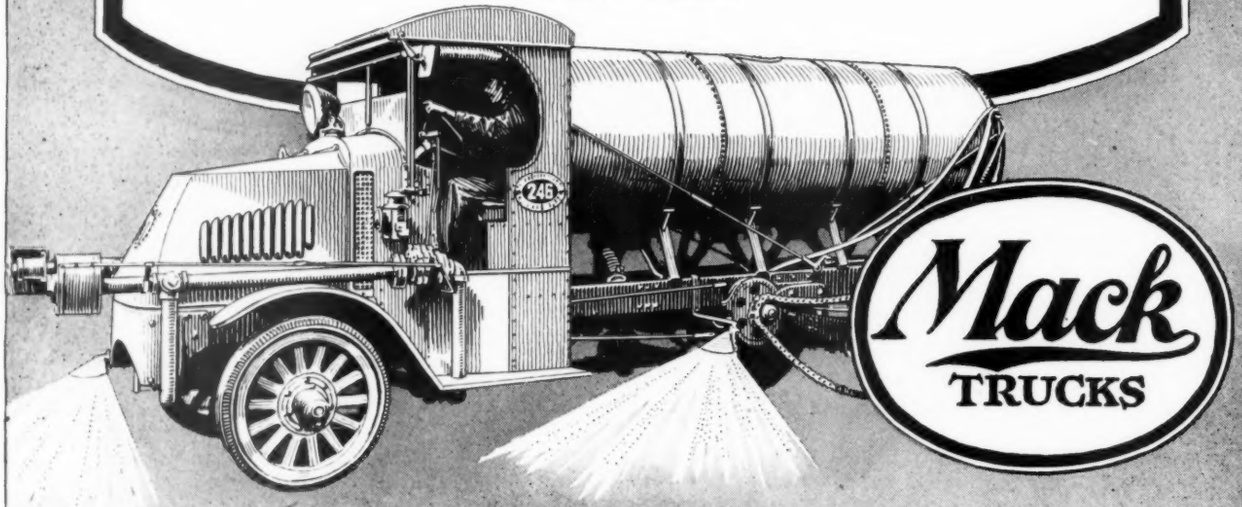

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In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

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Here is a typical instance of Wilson performance

THE DEPENDABILITY of Wilson Trucks was demonstrated on road grading work in West Virginia, where the Road Commission decided to reduce the grade of a 14 per cent hill.

The earth removed was used to raise the grade at the foot of the hill—a distance of about 200 yards from the steam shovel.

At the point where the fill occurred, owing to the steep angles of the sides and the soft material, *horse drawn vehicles were overturned on every other trip.*

But not so Wilson Trucks.

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Wilson Trucks in all branches of county and municipal work are every day displaying great efficiency. Wilson capacities, one to five tons—a model for every municipal and county need. Write us for further information.

J. C. WILSON COMPANY—36th Year

Export Office, 100 Broad St., New York. **DETROIT, U. S. A.**

LONDON – PARIS

Wilson

Dependable Motor Trucks

1, 2, 3½ and 5 ton—All Worm Drive

A Model for Every Municipal and County need.

MOTOR TRUCK OPERATION AND ACCOUNTING XLV

Operators of motor trucks in the municipal and county field are urged to send for publication in this magazine data on the performance of the trucks they have in service. The following letter and data just received from D. W. Burch, County Engineer of Butler County, (Allison), Iowa, are given as examples of expression of interesting opinions and statements of useful information:

"Butler County, Iowa, has owned a Duplex truck since the middle of 1917, and has received first class service and satisfaction from it.

"We consider that a four-wheel-drive is the only kind of a truck for our work. We have used this truck for everything that a county could possibly use it on. We have hauled bridge material of all kinds, gravel, dragged our roads, driven piling, pulled an 8-ft. grader and also used it to pull in a tractor which broke down. The cost for 1917 per ton mile, exclusive of depreciation and interest, was 16c; with depreciation and interest, 23 2/3c. A cost data sheet which I have made out for 1918, follows:

Operating Cost Data Butler County, Iowa, Duplex Truck, 1918

Total miles traveled	5,018
Miles traveled loaded	2,449
Miles traveled empty	2,569
Miles pulling drags	489.5
Average load of gravel in yds.	3
Average load of gravel in lbs	8,400
Average weight of misc. loads	6,000
Average weight equivalent of drags	10,000
Number of loads of gravel	272
Number of loads of lumber, tools, etc	100
Average distance load was hauled	2.84
Cost per ton mile exclusive of depreciation and interest—22.6c.	
Cost per ton mile after adding $1,000 depreciation and 6% interest on $3,025 for 12 months ($181.50), 33.32c.	
Value of truck Jan. 1, 1918	$3,025.00
Paid for driver	874.50
Paid for loading at pit	281.50
Paid for loading lbr., tools, etc	116.25
Paid for gasoline	645.37
Paid for oil and grease	150.37
Paid for repairs ($312.25 for new block, which was fault of driver)	430.00
Paid for storage	1.75

Use of Motor Flushers in Ottawa, Ont.

The commissioner of works, Andrew F. Macallum of Ottawa, Ont., in his annual report, states that the use of two power flushers mounted on motor trucks have thoroughly washed 18 miles of streets of various widths each day at a cost of $1.72 per mile. These flushers replaced 20 of the old horse-drawn sprinkling wagons. The trucks operated for 150 days at a cost of $4,650. The horses would have done this work at a cost of $16,800—a direct saving of $12,150. A Federal flusher has just been added which will replace 10 more of the horse-drawn outfits.

New Highway Transportation Company in Operation

The Highways Rapid Transit Company of Portland, Ore., has been organized for the purpose of maintaining freight service between Portland and Salem. This route is 55 miles one way, most of the line following the Willamette Valley, and passing through a number of small towns, among which are Oregon City, New Era, Canby, Aurora, Hubbard, Woodburn, Gervais, Brooks and Chemawa. Rates vary from 30c to 40c per 100 lbs. Three Federals are in use, two of 3½-ton capacity, making a round trip each 24 hours, thus giving day and night service; the other, a two-tonner, is used on pick-up and delivery service in Portland. Plans are under way to add one-tonners at each end of the line for this service, thus putting the two-tonner on regular schedule. The farmers patronize the line, sending in butter, eggs, poultry, vegetables and fruit, particularly on the night truck.

Truck Does Work of Five Teams on Texas Roads

Trucks that do the work of two or three teams are not rare, but here is a truck that does the work of five teams every day. According to Tom McWhirter, Ellis county road commissioner, Italy, Texas, he has had these results with his Federal on road building work: Five trips, each with 2½ yds. of gravel at a cost of $9.32 daily. Teams could only haul 2 yds. per day at $4.50; saving, $1.50 a yard, and 10½ more yds. hauled each day by the truck. Thus the truck does the work of five teams.

Mr. McWhirter recently unloaded four cars of gravel in eight days, 120 yds. at a cost of $54.56. Formerly a team could unload a car in 30 days at a cost of $135.00—saving $64.44. He says he has put enough lumber on the truck to build a bridge, go on and build it and have it ready for service while he is getting the lumber there with a wagon.

Data on the Cost of Bad Roads

"Few people fully realize the big part poor highways play in keeping up the cost of living," says Stanley C. Wilson, general manager of the J. C. Wilson Co. of Detroit. "If this were more generally known it would be an easy matter to get the voting public to endorse without question the good roads projects that are now being advocated in almost every state of the Union.

"To cite one real instance of bad roads costs: There is a 14-mile mud stretch of highway between Unity, Ohio, and Beaver Falls, Pa., on the Cleveland-Pittsburgh Pike, that for rough going in inclement weather was about the average bad country road the world over. The surveyor of Beaver county estimates that more than 600 trucks a week traverse this sector—new trucks going to the coast, farmers hauling to market, express lines, etc.

"Before this road was repaired we had occasion to send a fleet of Wilson trucks overland to our Pittsburgh distributor via this route, and our drivers reported 14 trucks stuck on this stretch of roadway. The Wilsons went through successfully, however, one of the 2-ton jobs carrying a one-tonner as passenger.

"Now, on the brick pavement from Salem, Ohio, to Unity, the trucks averaged about 16 miles an hour and 8 miles to the gallon of gas, while on this bad stretch the trucks averaged only two miles per hour and only eight-tenths of a mile to the gallon of gas, or 7 hours to make this 14 miles.

"Our cost record on this run shows an increase, for operation over the 14 miles, of $24 above the cost for good-road going. This extra charge includes supplies, driver's wages, gas, oil, tires, wear and tear, interest, depreciation, time lost, and so on. Now, if the surveyor's figures are correct, namely, that 600 trucks a week were going through this section, the total extra cost to the truck operators over a three-months

Service
MOTOR TRUCKS

First Aid to Road Building

For the good of our country, get busy on paving and road building work. Let there be no excuse for any man to say he can't find a job. Every city, town and county should take advantage of the present situation to get those long deferred improvement projects under way.

For the rapid, efficient and economical transportation of materials and supplies, depend upon SERVICE Motor Trucks—the trucks that keep going in spite of road or load.

Send for literature or talk to the nearest SERVICE distributor.

SERVICE MOTOR TRUCK CO., *Wabash, Indiana*

Distributors in All Principal Cities

NEW YORK—87-89 West End Ave. **CHICAGO—2617-25 So. Wabash Ave.**

period would amount to $178,800. In other words, this amazing figure would be a total waste, for it represents the amount above the ordinary truck operating costs for good roads over a like number of miles."

Truck Cuts Costs and Beats Express

Supplanting slow and uncertain freight service, a 5-ton Pierce-Arrow, since April, 1917, has been transporting velour and velvet goods for A. T. Baker & Company of Manayunk, Pa. The truck makes three trips a week from the mill to the company's finishing plant at Passaic, N. J., a distance of 110 miles.

"The firm kept a record of cost for a short time only, satisfying itself that the truck cost no more than the freight," said the local Pierce-Arrow dealer. "The mill officials mainly are elated over the great saving in time. Goods often were on the road from two to three weeks. Sometimes 10 days were lost on special express shipments. Now the entire output of the mill reaches the finishing plant every other day."

GRAMM-BERNSTEIN TRUCK AS OPERATED IN CONJUNCTION WITH A STEAM SHOVEL ON EXCAVATION WORK.

The truck has missed but few trips because of mechanical troubles, although the 40,000-mile mark has been passed. It carries 200 or more pieces, a load of nearly four tons. A further saving is effected by this method of shipment, for the goods do not have to be wrapped in burlap and baled as was done when they were forwarded by freight.

Eloquent is the fact that neighboring mills adopted this method of transportation after A. T. Baker & Company pioneered it.

Course in Highways Transport to be Offered by the University of Michigan

In a recent letter to the editor, Henry E. Riggs, Professor of Civil Engineering at the University of Michigan, wrote as follows of the proposed course in Highways Transport to be offered at the university:

"Our Department of Mechanical Engineering has given much attention to the automobile and automobile engineering, giving courses in machine design, internal combustion engines, design of internal combustion engines, modern automobiles, automobile engine theory, automobile engine design, automobile chassis theory, chassis design and automobile testing.

"Colonel Fishleigh, head of the automobile work, has just returned from service and the automobile work is to be very largely increased next year through a new laboratory and a large amount of equipment.

"A course in Highways Transport will be offered next year by Professor Fishleigh and myself, which is designed for men in both Civil and Mechanical Engineering and is intended to give them a background of history of transportation and of the economics of transportation with special reference to the problem of freight transportation on the highways and of the probable changes in type of construction that will be made necessary by the development of the motor truck.

"Some of the publicity regarding this new course seems to have been rather highly colored, as a number of letters are coming to us indicating that the papers have stated that we were putting in a new department.

"Such is not our intention. We are expecting to develop the work in both Highway Engineering and Automobile Engineering very extensively, the former because of the large highway building program of the state and the necessity for full co-operation by the university. The automobile engineering development is due to the fact that the work has grown way beyond the limits of our present space and equipment.

"The new course in Highways Transport is given in order to give to all of our men certain phases of the work which they do not now get and to lay greater stress on some of the economic problems which the motor truck will undoubtedly help solve, and on the changes which this class of traffic will necessarily have on types of highway design."

In a letter to President Hutchins of the university, relating to this new course of study in Highways Transport, Mr. G. D. Wilcox, director of sales and advertising of the Commerce Motor Car Co., of Detroit, said:

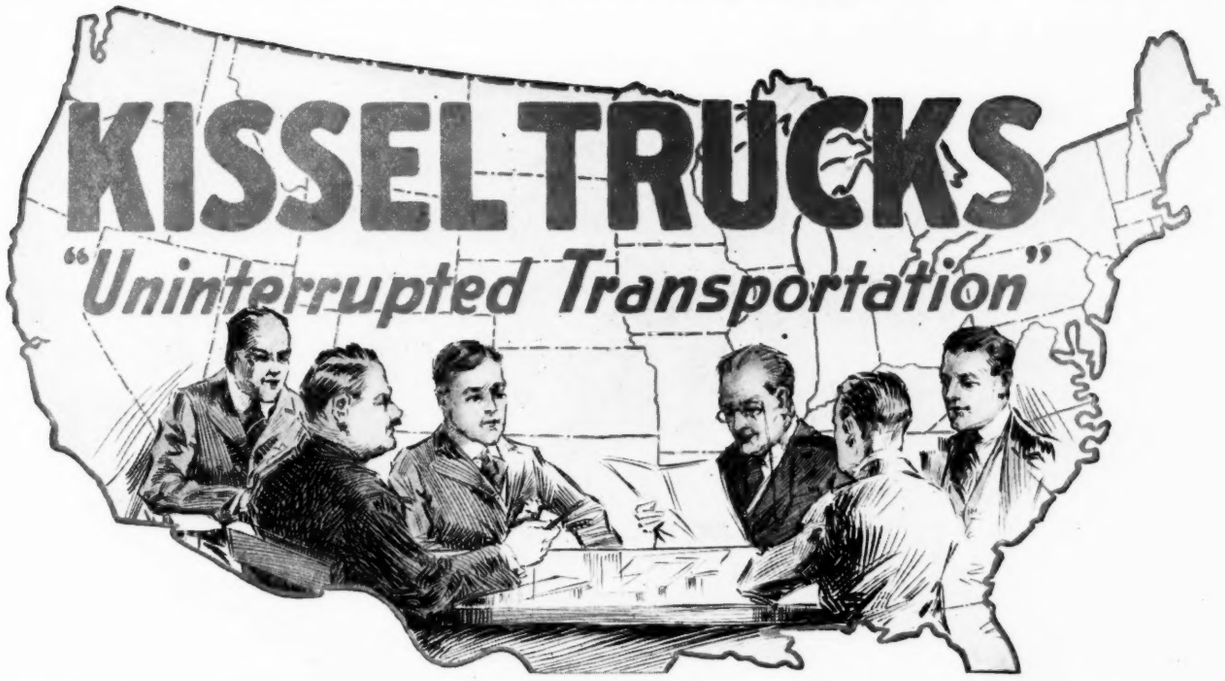
"It has always been the writer's contention that properly to merchandise motor trucks the salesman must be familiar with his product, its ability to be an asset to the merchant whom he is trying to sell. The ordinary automotive salesman does not deliver the proper amount of efficiency in the sale of a truck—what is absolutely essential for general good is for such sales to be handled by transportation engineers. Your course opens a wonderful opportunity for men interested in this work, which properly handled pays a handsome remuneration.

"We desire to inform you that we will be interested in having graduates from this course referred to us with a view to making connections with either our factory sales organization or in the organization of the numerous motor truck concerns throughout the country who sell Commerce Motor Trucks."

Commercial Possibilities of Local Markets Limited Only by Road and Truck Facilities

The following discussion, under this caption, was recently issued by the Information and Education Service of the United States Department of Labor, and deserves to be placed on record in this magazine which has done more than any other similar agency to bring the good roads and motor truck ideas together:

City limits no longer are fixed by municipal ordinance,



"Gentlemen—we are face to face with today's biggest problem—*Distribution*—"

"During 1917 and 1918—*Production* was the question of the day, and you know how we literally doubled our floor space and manufacturing equipment to meet the new program.

"You may have thought that we have on our hands an unnecessary amount of manufacturing equipment that will either have to be sold or left idle, thus representing a dead loss, but the last few months have brought such a volume of new business that we will have to practically utilize our full equipment to meet the re-adjustment demands of the Nation.

"And to do this economically and efficiently, we must face today's biggest problem—***Distribution.***

"The time has come when we must systematize and equip our transportation department so that it is equal to transporting the increased volume of goods. This means that we must at least double our motor equipment, eliminating all delays between the loading platforms at our factory and the receiving platforms at shipping points.

"Now, gentlemen—we cannot afford to invest in trucks we are not sure about—we cannot afford to take any chances of jeopardizing our shipping schedules by weakening our transportation department.

"We will make a big and costly mistake if we do not consider our truck purchasing from the same standpoint as any other investment. If a chain is no stronger than its weakest link then our transportation department is no more efficient than the make of trucks we employ.

"I am informed by our transportation expert that we need trucks of varying capacity, from ¾ to 1 ton trucks to 5 ton trucks, each of which must be capable of standing up under twenty-four hour service if necessary. "We need chasses that are hardy—unusually so—ones that are built to accomodate bodies of full capacity with a surplus of grade-climbing power, which calls for a motor of unusual ability and one built to motor truck specifications and requirements.

"We have made a thorough investigation of Kissel Trucks and find that they enjoy the confidence of executives in over two hundred different lines of business—large and small concerns who have paid particular attention to their transportation departments. Such a record proves that there is a reason for such confidence, and I suggested to our transportation expert to personally make a careful investigation. His report is as follows:

"Kissel manufactures most of the vital parts of his trucks. The Kissel-built power-plant is the last word in engine construction, because it is built especially to fit motor truck power requirements.

"Kissel has been designing and constructing trucks for eleven years. The line extends from a ¾-ton to a 5-ton model. In design, material and workmanship, they come up to the truck construction standard we have always insisted upon. I found the steel and other metal components are selected by skilled metallurgists with minute regard for the particular requirements to be met—then chemically analyzed, heat-treated and machined under the scrutiny of careful inspectors who reject all but work of the utmost accuracy.

"Also, the frame, axles, springs, brakes, wheels, etc., are all of liberal dimensions and highest grade construction.

"The worm-drive rear axles are of strong, sturdy steel forgings and are designed to carry the greatest burden of the truck's capacity at a reasonable percentage of over-load. An independent frame of cold-pressed steel is used on which the power plant is suspended.

"I examined scores of letters from satisfied Kissel Truck owners and they included some pretty big names. The ability of the Kissel Motor Car Company to solve their transportion problems proved that their trucks are built to fit the job.

"The Kissel Motor Car Company has a clean thirteen-year record without a reorganization or change in name. Its history is one of constant progress—their financial rating is high. Dun and Bradstreet not only prove that but we have the word of our bankers.

"When Uncle Sam called upon the industry to get on one hundred per cent production for the manufacture of Government trucks, Kissel was among the first manufacturers who accomplished this seeming impossibility.

"In short, the result of my investigation is that in purchasing Kissel Trucks we will get trucks of proven value—trucks that are making good in the same line of business as ours—trucks that will meet the heavy production schedule we have outlined."

We want every manufacturer—industrial executive and all others who employ motor trucks to rigidly investigate Kissel Truck performance in their line of business—make it a strictly business matter—call in the local Kissel dealer and he will work with you. It's the only way to solve your transportation problems for years to come—Catalogue on request.

Kissel Motor Car Co

Hartford, Wis., U. S. A.

but by automobiles and good roads. As a domestic market a city's territory is limited only by the possibilities of motor-truck transportation. Facility and economy in this field depends on the character of roads; the better the roads the bigger the city.

The American city which does not have a market diameter of 200 miles is not approximating its commercial possibilities; it hasn't developed its "home market" to its maximum business productiveness. In nine cases out of ten these cities permit their business opportunities to stall in a mudhole.

The United States Government has voted $266,750,000 for federal aid to states in their road-building program. This sum either is available or will be by the end of the fiscal year 1921. Under the federal-aid plan the United States Government stands practically half the cost of construction. If the states, therefore, avail of this opportunity to translate federal funds into permanent state improvements, the money spent on road construction by states and the Federal Government to the end of the fiscal year 1921 will be not less than $533,500,000.

Twenty years ago the market limit of the average city was about 10 miles. It was no farther removed from the heart of the town—courthouse square, if you please—than it was possible for a team to pull a loaded wagon on a dirt road and make the round trip between the morning and evening chores. Much is said these days about "seasonable employment," meaning such work as must be done in certain favorable seasons of the year. Seasonable employment is another term for periodic idleness. It will be eliminated in a 100 percent efficient industrial system. The mud road makes "seasonable business," which means that periodically there is practically no business because roads are impassable. A 100 percent efficient business system will eliminate periodic suspensions of business activities, even if to do so means the construction of hard-surface roads.

MACK 3½-TON TRUCK, USED AS A WRECKER BY THE BOSTON FIRE DEPARTMENT. EQUIPPED WITH POWER WINCH, DERRICK, TOWING ARRANGEMENT, SKIDS AND BLOCK AND TACKLE.

The Division of Public Works and Construction Developments in the United States Department of Labor has been investigating the effects of good roads and motor trucks on marketing conditions and the increase of business in commercial centers. The results of this investigation can be summarized in a statement of the situation in one city, Indianapolis, Ind. The shopping district of Indianapolis is a circle the diameter of which is approximately 200 miles. Three instrumentalities make this possible—interurban lines, roads which are open to travel the year around and automobile trucks.

Mr. Thomas Snyder, secretary of the "Return Loads Bureau" of the Indianapolis Chamber of Commerce, and to whom much credit for the success of the movement is due, makes the following statement on this Indiana city's effort to take advantage of the roads and motor trucks in developing business.

The country has heard much of the advantages of good roads and the possibilities of the motor car as assets to farming and business. Concrete examples of how cities are realizing on these assets are less frequently cited. There is no longer need of submitting arguments as to the economy and efficiency to be had in motor transportation. That has been established beyond question. It is equally well established that good roads are a paying investment, the better the road the greater the returns on the investment; a well-graded dirt road is a better investment than a chain of mudholes, a gravel pike is a better investment than a graded dirt road, a cement or hard-surfaced road is a better paying investment than a gravel pike—the point is "the best road a community can build also is the best investment the community can make." Indianapolis has the road system making it accessible, it has the motor trucks. One way by which the city uses these assets for business extensions is explained by Mr. Snyder as follows:

Indiana's Return Loads Movement

"The war's interference with normal transportation facilities was, perhaps, the deciding factor in the Indianapolis Chamber of Commerce's experiment to get the maximum utility out of motor trucks. The possibilities in this field had been realized by many, but it was only when war conservation encouraged new methods and necessity mothered business inventions, that the return loads movement was taken up.

"Indiana has an unusual number of motor trucks. Also it has good roads—not all it needs, but comparatively more, perhaps, than most states. The purpose behind the return loads movement is to see to it that a truck coming into Indianapolis under load, instead of returning empty, should be loaded; that an Indianapolis truck carrying a load to a farmer 25 or 50 miles out, or to a suburb, should have a load to haul back to Indianapolis. As has been said, this movement began to meet the transportation problem in war time. The interesting thing is, with its wonderful observation and its business expansion possibilities, the return loads movement did not stop with the signing of the armistice, but has grown until it now is a State-wide proposition.

"During the Indiana General Assembly, recently in session at Indianapolis, the effect of the return loads movement was a factor in securing legislation materially extending the State's road building program. Hundreds of truck owners, from every corner of the State whose experiences had shown them the wonderful possibilities of highway transportation, raised their voices in a great clamor for dependable commercial highways. Legislators were given definitely to understand that they

Schacht WORM DRIVE Motor Trucks

Eleven Years of Hard Usage Proves Schacht Stamina

IN THE contracting and building material fields, Schacht Trucks have been especially appreciated since they first went to work 11 years ago—appreciated for their clean, simple design and their brute strength and stamina.

They are not assembled trucks—every part is made in the same plant. Eighteen years of automobile engineering experience is built into them. For seven years they have been definitely out of the experimental stage.

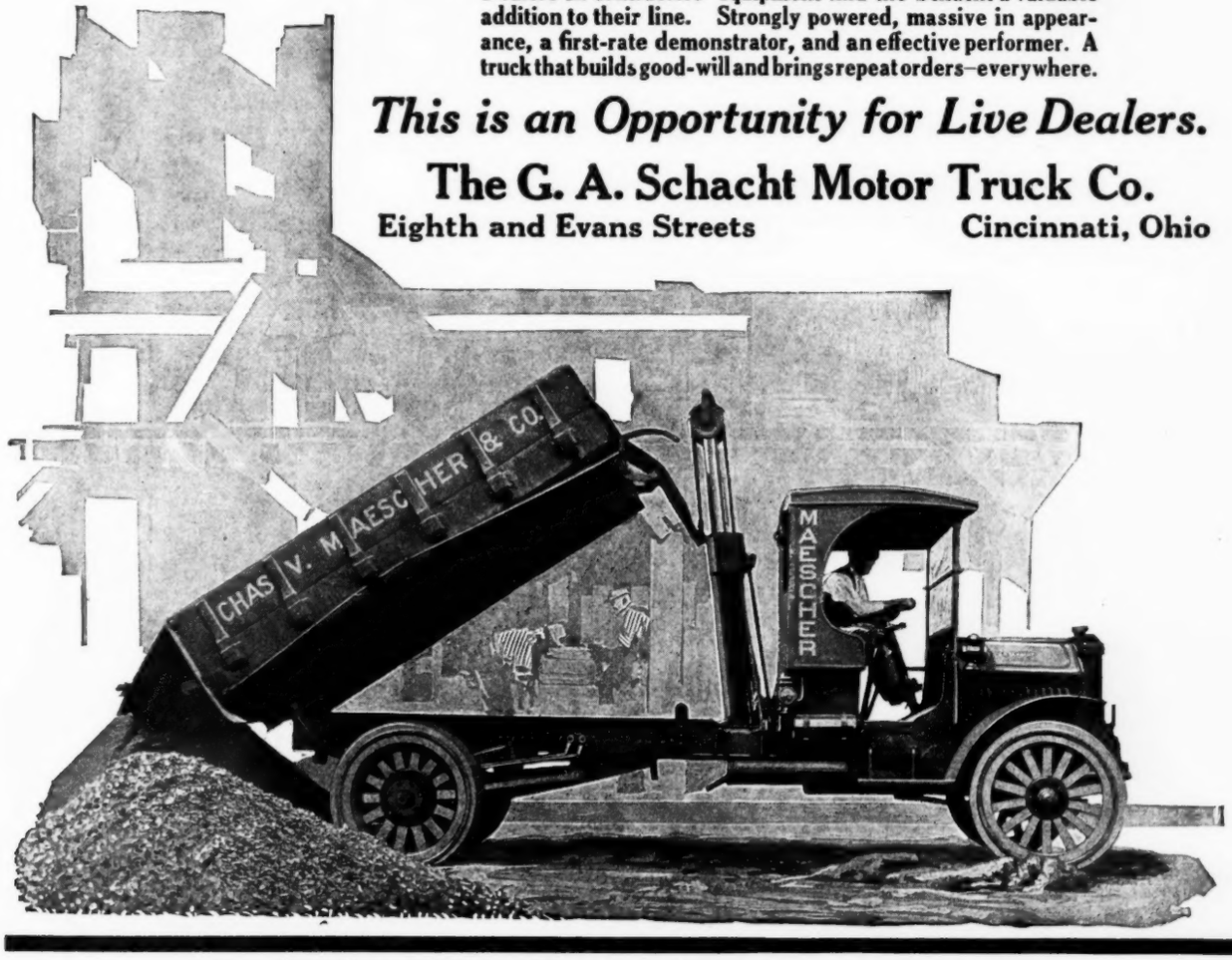
Hundreds of Schacht owners use their trucks with dump bodies for the heaviest kind of hauling under the hardest conditions that contractors encounter. They will tell you why they are glad they bought the Schacht, and why they buy them again and again when more trucks are necessary.

Dealers in contractors' equipment find the Schacht a valuable addition to their line. Strongly powered, massive in appearance, a first-rate demonstrator, and an effective performer. A truck that builds good-will and brings repeat orders—everywhere.

This is an Opportunity for Live Dealers.

The G. A. Schacht Motor Truck Co.

Eighth and Evans Streets **Cincinnati, Ohio**



would not be welcomed home unless they had cast their vote for a substantial highways bill.

"A bit of the history of the return loads movement, as conducted by the Indianapolis Chamber of Commerce, will indicate to what proportions the highways ultimately will serve society.

"The National Council of Defense had seen that as a force making for the increase of national assets, the motor truck and highways must be used more and more.

"In Indiana this movement met with the full sympathy of the State Council of Defense and the Indianapolis Chamber of Commerce, which early in 1918 established a Return Loads Bureau, interested not only in furthering the increased use of the motor truck as a carrier, but seeing that the motor truck was used to its full capacity. The logic of this is manifest. There is practically the same wear and tear in a return trip empty for the truck as if it were loaded, practically the same cost of operation and upkeep.

"The damage to the road by the empty truck is the same, or nearly so, as by the loaded truck. And as much man power is required for the empty truck on the return trip as if that truck were loaded. Thus it is that the motor truck and the men who handle them must, for the sake of pure economy, be made to work full time instead of half time.

"Indianapolis and Indiana are ideal for the development of the motor truck to the highest efficiency in hauling. The geographical center of the state, with lines of cities in every direction sending loads into Indianapolis daily, it seems the manifest duty to utilize those outgoing trucks and to encourage larger loads coming into Indianapolis. This for the good of all.

"Farmers are sending their produce into Indianapolis by motor truck. Over every thoroughfare entering Indianapolis these trucks came daily, and when they did not carry back loads it was because the truck men or their patrons did not see the profits that would accrue to them, perhaps in quicker service, in the use of these motor trucks on the return loads.

Benefits to Wholesaler and Retailer

"For the Indianapolis wholesaler these trucks offer a wonderful service. The motor truck solves many a problem of the shipping clerk and the traffic manager. The haul to the freight depot and the reloading is eliminated, and merchandise consigned for some point in Indiana, via motor truck, is delivered at the door of the retailer. And the merchandise comes in better condition than by rail.

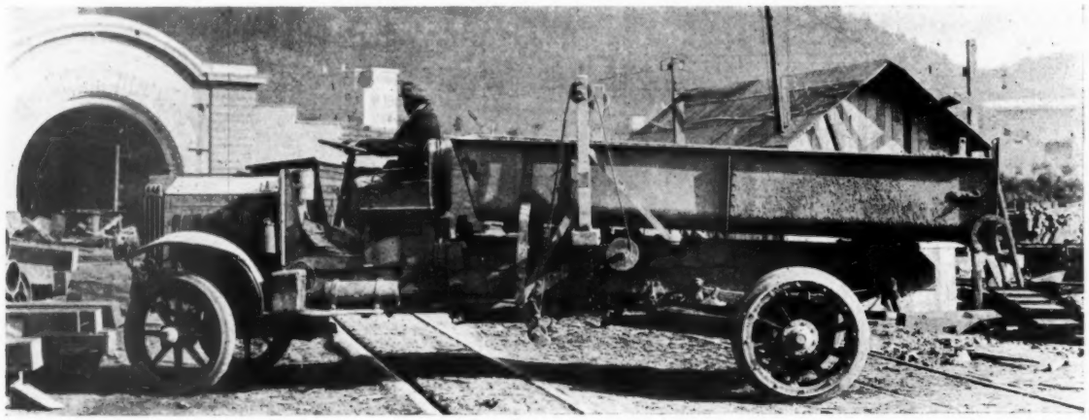
"And the retailer benefits, too, for he is in daily touch with the city. His supplies can be ordered as he wants them. Stock of goods can be kept without a large capital investment. The excitement that used to come with the 'rush' order is eliminated, for the 'rush' order of the past becomes the 'usual thing' with the speed of the motor truck.

"The motor truck is doing much for the farmer. The great markets of the world are open to him more and more, because the motor truck brings him into the shadow of the city market. The farmer makes more profit by selling on the exact day he wants to sell. It enlarges his markets, too, for the city stands ready to consume or to ship all his products and do it without quibble. Thus, with the increased markets, the farmer sees the benefits of increased production and larger acreage.

"Result, the city man pays less for his stuff from the country—for his fruits, meats, vegetables, butter and eggs—but the farmer, because of increased production, has made more money.

"And the man of the city, far from the farm and the country, living from the produce of the farm and country, gets better milk—better food generally—because the motor truck is hauling his foodstuffs over the highways to the big city markets.

"The motor truck inevitably enlarges and betters the social scheme. The visualization of its utility has been the best argument for better roads and better care of them, for only on good roads can the motor truck do the work, winter and summer—expected of it.



RIKER 5-TON TRUCK AS OPERATED IN HEAVY MOUNTAIN HAULAGE ON CONSTRUCTION WORK AT SAN FRANCISCO, CALIFORNIA.

"Investigation as to what the Indianapolis Chamber of Commerce bureau is doing shows some real work, some real enthusiasm, with the proper insight into the future and building accordingly. A committee from the Wholesale Trade Division of the Indianapolis Chamber of Commerce, and the Indiana Automobile Trade Association direct the work of the Return Loads Bureau. In an attempt to ascertain the volume of tonnage hauled through the Return Loads Bureau, a questionnaire and report blank was sent to Indianapolis shippers, asking them to make a record of shipments leaving the city over the highways from September 9 to 23.

Loads Hauled by Motor Truck

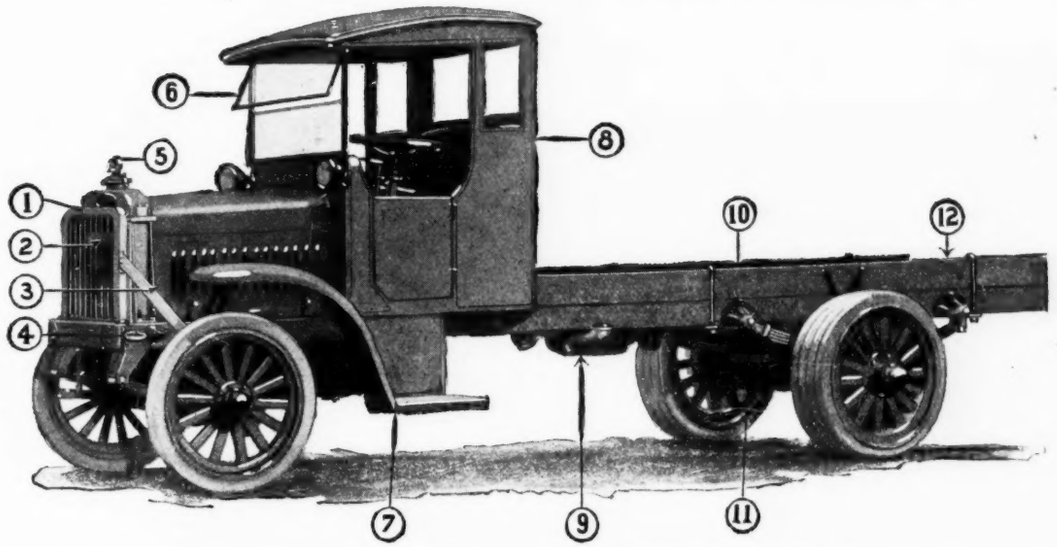
"The reports from this source showed during that period that at least 108 tons were sent out of the city on trucks that otherwise would have run empty.

"Other sources of information, among them the Indianapolis Transfer Association and the Stock Yards Return Loads Bureau, not covered by questionnaires and shippers' reports, showed an addition volume of 150 tons, making a total of 258 tons shipped on trucks that would have required the use of railroad freight service.

"On the basis of full carload shipments, this has been a saving of 32 freight cars for Uncle Sam during a period of two weeks when war demands on transportation were most pressing.

"From one to two hundred motor trucks reach the city of Indianapolis every day with live stock or agricultural products; these tuckers have been taught the lesson of conservation and better business in the return-loads idea. They come with

First Completely Equipped Line of Heavy Duty Trucks



2-ton, Worm-drive—$2700—No Extras

Built by B. A. Gramm

In price this two-ton Gramm-Bernstein—completely equipped as shown—is under the average asked by 61 manufacturers for stripped chassis only

Not an extra to buy. Equipment includes:

(1) Sturdy radiator guard, attached to frame independently of radiator—the Gramm-Bernstein type adopted for Liberty Trucks.

(2) Radiator shutter, operated from dash.

(3) Rear radiator shroud devised by B. A. Gramm, and adopted for Liberty Trucks, to promote cooling efficiency.

(4) Pig-tail towing hooks at front end.

(5) Motometer, to indicate temperature of engine.

(6) Exceptionally rugged ventilating windshield.

(7) Front fenders and steps.

(8) Standard Gramm-Bernstein cab, with doors and winter curtains.

(9) Transmission is the patented Gramm type, with gears always in mesh, assembled on a six-spline shaft, without a single bolt, nut, stud, set-screw, pin, key or anything else liable to work loose and fall out. A highly valuable, exclusive feature.

(10) Body sills of seasoned ash, ready for mounting the body.

(11) Patented wick oilers on all spring bolts.

(12) Spring drawbar at rear end, supported by extra cross member.

On account of engagement by means of dog-clutches, the transmission gears *cannot be stripped.* Absolutely proof against a driver's carelessness. Cannot get out of alignment.

Chrome nickel steel gears. Extremely tough to stand wear and heavy duty.

The one transmission which is proof against every trouble that makes the ordinary truck sliding-gear transmission a prolific source of expense.

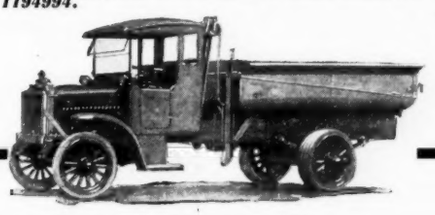
Power take-off (Gramm basic patent No. 1194994) can be attached to drive hoist for operating dump body, winch, or log roller.

Hotchkiss drive, first successfully applied to trucks by B. A. Gramm, and adopted for Liberty Trucks.

All Gramm-Bernstein 2, 2½, 3½, and 5-ton worm-drive models are now completely equipped as noted.

Many Gramm-Bernstein Trucks are being sold with dump bodies for use in road-building, public works and general building operations.

Dealers and users, in purchasing motor trucks and passenger cars with any kind of power take-off for operating hoist, winch, log-roller, tire pump, etc., should assure themselves that such device does not infringe upon B. A. Gramm's basic patent No. 1194994.



GRAMM BERNSTEIN

GRAMM BERNSTEIN

The Gramm-Bernstein Motor Truck Company, Lima, Ohio, U.S.A.

Pioneers Since 1901—Builders of the First Liberty (U.S.A.) Truck

shipping orders from merchants of the smaller towns along the highways over which they travel, and return loaded with groceries, hardware, drugs, dry goods, agricultural implements, and other products consigned to points along their route.

"The Indiana Transfer and Warehousemen's Association has become actively interested in a State-wide return loads bureau, and have a central office in the Indianapolis Chamber of Commerce, to which each trucker reports before starting a cross-state trip.

"By this method the empty truck is rapidly disappearing from the Indiana highways, the cost of highways transportation is being reduced, and the demand for it is rapidly increasing.

"For the movement of household furniture for any distance less than 200 miles the motor truck and the highways is the quickest, the cheapest, and the safest way."

In the light of this Hoosier city's experience, the Department of Labor's statement that road building will be a profound factor in reviving and stimulating business takes on new significance. Not only does road building improve present labor conditions and stimulate those industries which produce road materials, but, also, as is shown by the Indianapodis project, in conjunction with the motor car, it extends the trade area.

How the Problem of Motor Transportation Will Be Solved

By R. E. Fulton, Vice-President International Motor Company, New York City

The problem of good roads is only one part of a bigger problem—transportation. It is necessary to state this obvious fact for the simple reason that the obvious is usually the last thing we see. The other half of the problem is vehicles, plus their motive power.

Good transportation has resolved itself into two things: good roads and motor trucks. A favorable sign of the times is the growing recognition on the part of good roads advocates that good roads exist for the use of better transportation media—the motor truck and the automobile.

The motor truck is not only replacing horse transportation, but in many cases it is supplanting railroads. The motor truck is the solution of the modern transportation problem.

In addition to the unlimited use of motor trucks for delivery purposes, they are substituting for railroads where the railroads themselves are using them to replace spurs, which are a source of expense and difficulty. Also in inter-city shipments large truck companies operate transportation service for merchandise, supplies, etc.

Highway Transportation as Practiced by Callan Bros. of New York

An idea of the extent of this form of transportation which is calling for better roads and the best motor trucks is given by the example of Callan Brothers of New York, who operate a motor truck transportation system within a radius of 400 miles of New York City. They have a fleet of over forty 7½-ton Mack trucks. They have closely connected their service with the Erie Barge Canal which runs from Buffalo on Lake Erie across the state of New York, joining the Hudson river at Troy, a distance of 387 miles.

Callan Brothers have linked their eight large warehouses, with a storage capacity of 900,000 sq. ft., and their motor truck service with the terminals of the canal in New York City and important upstate trans-shipment points along the canal. The Harlem river ship canal is eight miles long. Callan Brothers unload freight direct from the canal barges at their warehouses alongside their yard for shipment by their large fleet of motor trucks and delivery direct to consignees or to Callan Brothers' warehouses to be held for future delivery in New England, New Jersey, Delaware, Pennsylvania, or other seaboard states or to trans-Atlantic piers in New York City.

These motor truck transport systems are the outcome of the inability of the railroads to handle the great quantities of freight which congested railway traffic in all parts of the country. This condition is responsible for the discovery of the real value of the motor truck as a transportation medium. Motor trucks were used in connecting the broken lines of railroad shipping and are replacing the use of local freight trains on "short hauls" to a considerable extent, thereby releasing freight cars for the more essential shipments on longer hauls.

Truck Haulage Reduces Handling

Shipping freight by motor trucks means less handling, lese damage and safer delivery. It eliminates at least five handlings of goods as shipped by railroad: First—from factory or warehouse to freight station; second—loading from freight station or truck to cars; third—unloading at destination from cars to trucks or freight station; fourth—unloading from trucks to stores, factories or warehouses, and fifth—handling in case the goods are removed from the car to freight station and held until the consignee sends a motor truck to remove them.

Distances considered practical for motor truck transportation are held by various authorities to average from 100 to 300 miles. In special instances trips of 400 miles have been made. An exceptional demonstration of long distance hauling is the fleet of motor trucks which the Goodyear Tire & Rubber Company operate between Akron, Ohio, and Boston for the shipment of fabrics and rubber supplies. These machines make the round trip of approximately 1,560 miles in from six to nine days, depending on the weather and road conditions. They are driven between terminals with no stops other than for meals and supplies. Each truck is manned with two drivers, one of whom drives while the other sleeps.

The establishing of long distance motor truck service during the emergency of the war is undoubtedly the forerunner of a continuation of such service on an even larger scale in the era of peace. The service is demonstrating to manufacturers and merchants that motor truck transportation is the only way to escape delays caused by slow moving local railroad freight trains and the loss of time that had frequently been experienced even before the railroad freight congestion became so acute.

Department stores in New York City and Philadelphia are extensively patronizing long distance motor truck freight service. This method of transportation insures prompt receipt of goods.

The products carried by motor trucks have hardly any limitations. Recently several tons of finished leather, valued at $40,000, were shipped by motor truck from Philadelphia to New York over night. Railroad service at the same time would have required from four to seven days. Machinery manufacturers and cotton and woolen mills in New England cannot well afford to await the arrival of slow incoming freights, so they have their raw materials delivered to them by motor trucks in express time. Heavy machinery is delivered direct from shops and foundries in Connecticut to factories in New York City. Wholesale grocers deliver in Washington from warehouses in Baltimore. Tons of high explosives that railroads refuse to carry are delivered by motor trucks with but one handling after they leave the chemical works. And so on "ad infinitum."

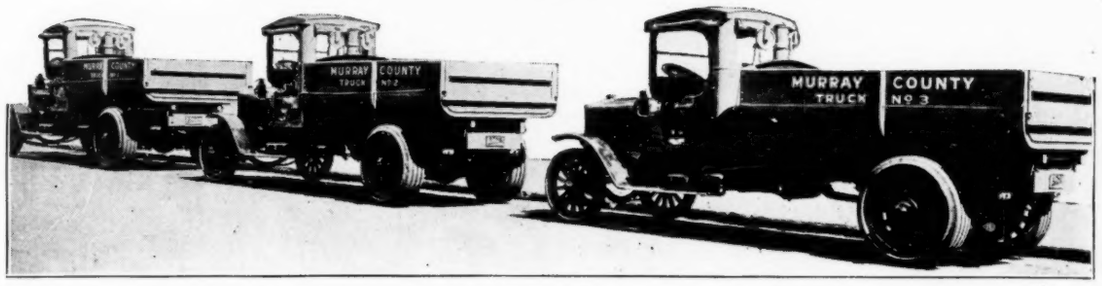
Rural Motor Express

Farmers, too, are turning to motor truck transportation. Thousands of them are now served by motor truck express lines without which they would hardly be able to ship milk or farm produce. This service has enabled them to materially increase their production, with a certainty of reaching the market. In Maryland there are 20 such lines carrying supplies into Baltimore and Washington. They have a daily ca-

The Seal of Dependable Performance

ACME THE TRUCK OF PROVED UNITS

Trade Mark Registered U. S. Patent Office



Fleet of **Acme Trucks,** equipped with special hydraulic gravel dump bodies, being used in Murray County, Minnesota. Write for *"Pointers to Profits,"* which tells why the **Acme,** the truck of proved units, is the accepted truck for municipal and county work.

ACME MOTOR TRUCK COMPANY, 428 Mitchell St., **Cadillac, Mich.**

ACME PROVED UNITS
Continental Red Seal Motor
Timken Axles and Bearings
Timken-Detroit Worm Drive
Cotta Transmission
Borg & Beck Clutch
Eisemann High Tension Magneto
Rayfield Carburetor
Centrifugal Type Governor
Heat-treated pressed steel frame
Ross Steering Gear
Detroit Springs

ACME
REG. U.S. PAT. OFF.
The Truck of Proved Units

In the **Acme** truck only such units of construction are used which have been endorsed by the engineering experts of the automotive industry.

These units, known as **"Acme Proved Units,"** were brought together without consideration of cost and built into the **Acme.** You can count on **Acme** Performance in advance because of these standardized units.

"Cannot Praise Burch Stone Spreader too Highly"

says a Contractor who has saved money with his Spreader

Read what C. W. Fuelling, of the Fuelling & Krudop Construction Co., of Ft. Wayne, Indiana, writes about this labor and money saving Stone Spreader for road builders:

Burch Stone Spreader in Operation.

"Regarding the **Burch Stone Spreader** we are using on our work here (Pioneer, Ohio), we cannot praise them too highly. Using this Spreader we can handle as many as twelve motor trucks on one job. The stone is spread in such a manner that it is an easy matter to finish the work. The Spreader also enables us to haul during the night, because with it there is no danger that the truck drivers will become careless and dump the loads in one spot. **Our records show that we save considerable money by using these Spreaders."**

These Spreaders practically eliminate labor and entirely eliminate rehauling and shoveling. They conserve stone by keeping the thickness uniform as specified.

The **Burch Stone Spreader** can be attached to any motor truck. It soon pays for itself in saving labor and material.

Get Prices and Full Particulars from

THE BURCH PLOW WORKS CO., Department A **Crestline, Ohio.**

pacity of 115,690 ton-miles and haul more than 500 tons a day into these markets and take back an equal amount of merchandise to farmers and country merchants. The United States Food Administration states that one man with a truck can haul as much farm produce as three men with wagons and cover three times the distance.

All of this emphasizes in a general way the conditions that have obtained in railroad transportation and explains why industrial and commercial interests are turning more and more from what had been considered "short hauls" to the use of motor trucks for transportation. Business men first turned to motor truck service to meet an emergency; now they are turning to it to insure against interruptions and delays in carrying on their operations.

When counterbalanced by their capacity and more extended distance of travel, the upkeep of motor trucks has proved to be less expensive than the maintenance of horses. One of the big Mack trucks of the Callan fleet has been in service for four years, and it has never had its engine taken down for a general overhauling. It is still in commission, carrying its rated capacity load every day.

Callan Time and Distance Schedule

The following is a schedule of the distances and time made by Callan Brothers' 7½-ton Mack trucks:

	Miles	Hours Per Trip
New York to Philadelphia	100	12
New York to Baltimore	188	22
New York to Dover, Del.	172	21
New York to Waterbury, Conn.	95	11
New York to New Haven, Conn.	77	9
New York to Bridgeport, Conn.	58	8
New York to Hartford, Conn.	113	16
New York to Springfield, Mass.	139	18
New York to Worcester, Mass.	190	23

The foregoing gives a practical insight into the transportation methods of the immediate future. Motor truck transportation has come to stay. The problem now is to perfect and develop it.

Engineers who for years have been engaged in the building of better roads are now including in their efforts the problem of better motor transportation. They realize that good roads are but a means to an end—efficient transportation, the getting of things from where they are to where they are needed in the best, quickest and most economical manner.

Within a range of 50 to 100 miles the motor truck is today easily a competitor on better than even terms with the railroads. All that is needed to widen the limits of this zone is the building of smooth, hard-surfaced highways of adequate strength. Government recognition has been taken of this fact, and a new government department is to be born out of the stress of the great war. Its purpose will be to create a country-wide system of roads that can be used in winter as well as summer. This has the double strategic value of a strictly military measure and of relieving railroads. It is now proposed that topographical maps be prepared showing our present loosely constructed and unsystematic highways. With these as a basis, a plan will be made of an interlocking system of roads, upon which the products of the nation may be moved from coast to coast, and from the Canadian border to the Gulf of Mexico. New and sounder types of roads than heretofore will have to be constructed, having as the first consideration the greatly increased wear and tear of heavy trucks. Even the best of our existing highways are not calculated to withstand continuous traction of heavy duty trucks.

The problem of transportation will be solved by good roads engineers and motor truck engineers working in co-operation to achieve the desired end.

Cuts Expenditure of Time and Money in Half

A saving of 50 per cent in Wages and Time is credited to the **Heltzel "Lightning" Loader** by William G. Tonkel, County Highway Superintendent of Allen County, Fort Wayne, Indiana.

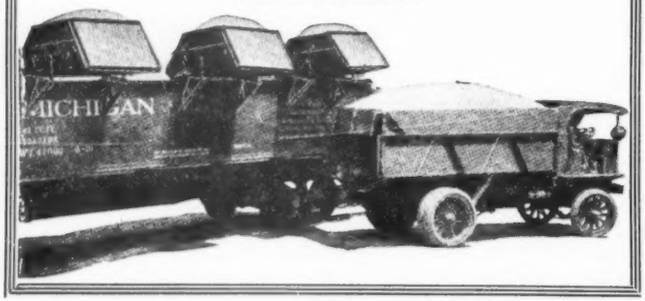
By installing two "Lightning" Loaders he was able to dispense with five men. He found he could load a 2½-ton truck in 30 seconds. On the work in question the loaders so speeded up operations as to make one truck do the work of two.

This is a record of performance to command the attention of all.

Get Prices now from the

Heltzel Steel Form & Iron Co.

WARREN, OHIO.



Contracts and Bids

Things are happening now in the public works field.

Despite the high prices of labor and materials, and all the alternating rumors and denials fed to the public by the newspapers, the public works field is active.

Each business day in the year we publish a bulletin of news covering the public works activities of the United States.

Here is a significant fact. Contracts Awarded and Bids Asked have almost crowded Prospective Work out of these reports for the time being. Things are happening *right now.* If interested in such a bulletin write to

Municipal and County Engineering

538 S. Clark St. CHICAGO, ILL.

SINCE 1890

Municipal and County Engineering

Under this and its older titles (including, for many years, "Municipal Engineering") has been

Supreme in the Public Works Field

This high-class monthly magazine is edited largely by workers in its field. Fully 90 per cent of the reading matter it contains is written for its exclusive use by leading authorities in the several branches of municipal and county engineering work. It is devoted to: The Design, Construction, Operation and Maintenance of all Public Works. Throughout the war period it has been loyal to its field. No effort was made to convert it into a cantonment or shipyard newspaper. It steadily urged its readers to prepare plans for construction projects to be launched at the end of the war.

Published monthly, it reaches its readers just often enough to be welcome and to be read.

To reach the Public Works Field use

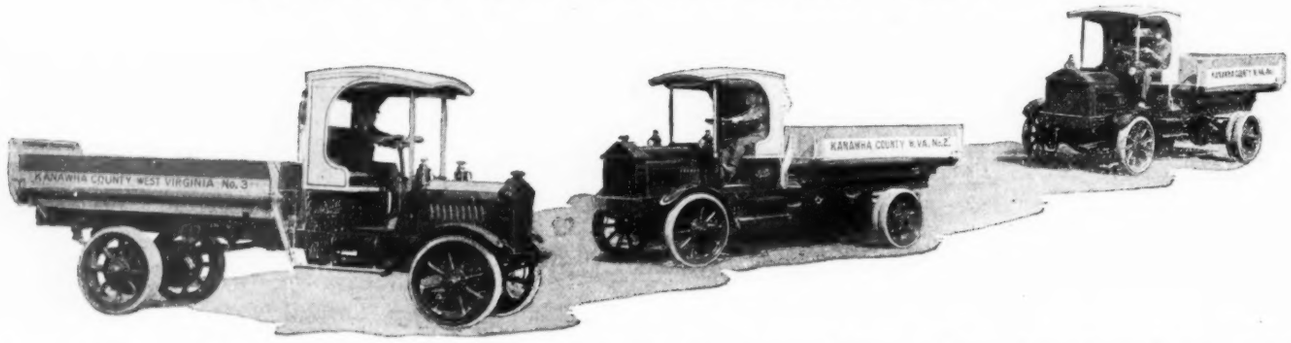
Municipal and County Engineering

538 S. Clark St., Chicago, Ill.

(***Sample Copies, Advertising Rates and Circulation Statements Furnished***)

Five HALL Trucks are owned by Kanawha County West Virginia

and are used with 100 per cent satisfaction in all kinds of county work.
The view illustrates the first three in this fleet of five trucks.



Read this letter about these HALL Trucks, written by the Engineer and General Superintendent of Permanent Road Construction of Kanawha County, who is also a Division Engineer of the State Road Commission.

Endorsements of this character are most eloquent. Here is a case where a single county has built up a fleet of five **Hall** Trucks. Note that all were not bought in a single purchase, but at different times.

OFFICE OF
P. J. WALSH
ASSOC. M. AM. SOC. C. E.

ENGINEER AND GENERAL SUPERINTENDENT
PERMANENT ROAD CONSTRUCTION
KANAWHA COUNTY, WEST VIRGINIA

DIVISION ENGINEER
STATE ROAD COMMISSION

CHARLESTON, W. VA., April 15th 1919

W. D. Riggs, Manager.
Good Roads Machinery Co.
Pittsburg Pa.

Dear Sir:-

In reply to your letter, with reference to Service received from the Three Lewis Hall Trucks owned by Kanawha County Court.

Have received 100% efficiency from these Trucks since they have been under my jurisdiction, and the Specifications under which they are constructed are the highest, embracing, Continental Motor, Zeneith Carburetor, Bosch Magneto, Timken Bearings, and Wood Hydraulic Hoist, these parts undoubtly put the Hall Trucks in the first Class, and in fact am so well pleased with them that I asked the County Court to purchase two more of the Two Ton size.

Yours truly
P.J. Walsh

P. S. Forgot to mention that a Telegram for repairs to Detroit, assures us of an immediate shipment, and account of such service we keep no parts on hand.

P. J. W.

These Repeat Orders Tell the Whole Story.

Thus the later purchases are proof positive of full satisfaction with the earlier purchases. A stronger endorsement of the **Hall** Truck in County Service could not be asked by any county authority in the market for trucks.

FOR SERVICE HAUL it in a HALL FOR ECONOMY

THE LEWIS-HALL IRON WORKS

Manufacturers of the HALL Truck
(Established 1873)

Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

EDITORIALS

To Promote Interests of Public Engineers

The public engineer is to be the chief beneficiary of the labors of the American Association of Engineers during the next twelve months. The annual convention of the Association was held in Chicago on May 12 and 13 and at that convention the executive committee of the Association was instructed to appoint a committee of three or four men to promote the non-technical interests of engineers in public service, including those employed by the federal government, the several states, municipalities and counties. Stated in plain language the object of this movement is to increase the compensation of engineers in public service and to lengthen their tenure of office.

Public engineers should now do all possible to help themselves as they are to be so greatly helped by the organized efforts to be put forth by the Association. Readers of this magazine are familiar with the work the Association has done recently on behalf of technical engineers employed by railroads. A conference of such engineers was held in Chicago to adopt a minimum salary scale for the various grades of engineers recognized by the conference and this scale was submitted to the United States Railway Administration with every likelihood of early adoption or, at least, substantial recognition.

Engineers in public service may confidently expect the Association to call a similar conference of public engineers, or groups of such engineers, when the right time arrives.

The Association is looking for suggestions and they should be freely offered. The Association is asking this question: "What can we do to help the engineer in public service?" The engineer should not fail to answer this question in his own way and in accordance with his own views. Letters on this subject addressed to the editor of this magazine will be promptly brought to the attention of the proper officials of the Association. Some of the letters so received will be published in this journal as it is our aim to stimulate discussion on this point to bring out all shades of opinion and to assist in getting all constructive suggestions on record as promptly as possible.

The public engineer should immediately apply his mind to this problem for nothing in history has so closely touched his vital interests. Here is a chance for him to assist in thinking out a plan for increasing his salary and the security of his position. Every public engineer who reads this magazine should at once think this matter through to the point where he is ready to propose a plan and to recommend procedure to make the plan effective. Let us have a letter embodying the ideas of the individual reader.

The editor has been a close student for years of all matters affecting the welfare of engineers and his sympathetic interest will not be questioned. Perhaps a few suggestions will, therefore, be accepted in the friendly spirit in which they are offered.

In writing an answer to the question: "What can the American Association of Engineers do to help the engineer in public service?" the correspondent should, above all else, stick to the text. If the reader has access to file copies of any engineering magazine published since 1875 and will look them over he will find that for nearly a half century engineers have written a very great deal on this compensation question. Nine-tenths of all such writings have been elaborations of the obvious. Stating the obvious fact that engineers are underpaid the various generations of engineers have most solemnly proceeded to prove it, digressing ever and anon to feel sorry for themselves. The futility of such discussions has been amply demonstrated. Start with the undisputed fact that the engineer in public service is underpaid and then state what you think should be done about it. For example, if you think engineers should become affiliated with labor organizations by all means say so. The editor is emphatically opposed to such affiliation, but if this discussion is to be of any value all shades of opinion must be frankly and vigorously expressed. While we do not favor affiliation with labor organizations our respect for the man who does favor that course and defends his views is much greater than it is for the man who has no plan to propose yet rambles all over the place in endless discussion. Labor organizations have their place, as all the world recognizes, but it would be a mistake, in our opinion, for engineers to go at once from one extreme to another. The editor purposely refrains at this time from expressing his opinion as to what should be done; of much greater importance is it to learn what engineers think should be done.

In discussing this matter it should be kept in mind that questions of definition are relatively unimportant. Some feel that the engineer is not properly appreciated by the public because the word engineer has been so widely and so loosely applied. Quite likely that is so but please bear in mind that the courts have defined the word in various states and the public has its own ideas which are not easily changed. If all engineers could agree on a definition of the word engineer, which they cannot, it would take generations to get the public to adopt it. And at that time the engineer might be, and probably would be, as poorly compensated as he is now and always has been. So let us keep off the subject of definitions of the word engineer.

Another thing that has been greatly overworked is that intangible something called "the dignity of the profession." Ideas of dignity differ. It is well to recall the Indian who, arrayed in his war paint and a white man's two-gallon silk hat, and little else, fancied that he presented a dignified appearance. The engineering profession has a dignity that approaches the majestic but this is in spite of and not because of inadequate compensation. If the engineer's dignity interferes with his efforts to obtain proper compensation he should revise his idea of dignity. Very little of value can be said of such an illusive quality as dignity in this purely business matter.

Still another thing to remember is that this movement is intended to benefit the man who is now an engineer and who expects to remain an engineer. If any man has ideas on how to get out of the engineering profession let him retain them for expression in a

discussion on that subject. Engineers as individuals are becoming farmers, merchants, salesmen, bankers, etc., but however much they may prosper in the change cuts no figure in this case. Our interest, and the interest of the Association, is in the engineer who remains in the engineering profession rather than in the one who leaves it or who flits about in a twilight zone.

These suggestions are offered in the hope that they will emphasize the imperative importance of being specific and of going straight to the point. Do not trifle too much with corrollaries. The engineer in public service is not properly compensated and he loses his job altogether too often. Now what do you propose doing about it? That is the question.

Is There a Propaganda for High Prices?

The average citizen is becoming somewhat cautious about accepting as true any sort of argument vigorously set forth and consistently maintained. He is inclined to regard everything of that sort as some species of propaganda calculated to lead him where somebody wants him to go. This is a natural reaction from swallowing whole everything offered during several years of war. From being too credulous he has become too skeptical; where he formerly believed nearly everything he now believes very little. This is all very well illustrated in the case of the present prices of materials used on construction work. There have been open charges of profiteering brought against the material men. These charges have been made by governors of states and by obscure citizens. It is all part of the prevailing suspicion about the other man's prices being too high.

Attempts to quote the history of price performances in similar periods following other great wars and arguments that because labor is high and everything else is high the prices of construction materials must also be high, have alike been regarded by many as merely so much propaganda. But little by little, all too slowly, citizens, officials and entire communities are finally becoming convinced that these prices are not too high and construction is proceeding in such communities.

In Illinois there has been much well advertised suspicion of prices. The report of the Dailey Joint Legislative Committee that has been investigating the cost of production of building and construction materials needed in the Illinois post-war reconstruction work was made public on May 7. This report was the result of weeks of investigation during which a great many witnesses were examined. It was commonly supposed that the committee would be able to prove that prices are needlessly high and thus force them down. In view of all these facts the following quotation from the conclusion of the report is most illuminating:

"We are driven to the inevitable, logical conclusion that existing prices will not decline materially, and that those prices express a new and substantially permanent level upon which present and future business must be conducted.

"We believe it to be our duty as public officials to advise the public not to delay building projects in the hope prices will come down materially. We do not believe they will.

"All contemplated buildings, homes and improvements should be started now. Reconstruction can only be accomplished in its real sense by every citizen subscribing to the doctrine 'Buy now, build now.'"

It is to be hoped that the results of this Illinois investigation will be accepted at full value elsewhere as they have been in Illinois. The state has awarded many miles of road contracts at this writing and many more are in prospect.

The searching Illinois investigation just recently concluded amply demonstrates that there is no propaganda under way to keep the prices of materials up. This ought to be the last hurdle for the construction industry.

One of the Things That Hurt Engineering

A man who has grown old and prosperous in the practice of engineering was recently discussing some of the things that hurt engineering as a vocation. He expressed strong disapproval of one practice that is harmful to engineers and engineering and even went so far as to assert that it has ruined the business of consulting engineers in a certain state in the middle west. He referred to the taking of consulting work by the members of the engineering faculties at state engineering colleges. Of course, this is not a new practice.

The practice is not wholly bad for the teacher needs to keep in touch with practical affairs and this requires some work in the field. This has always been the justification of the practice and is all right as far as it goes. The fallacy involved in this argument is that the faculty man who acquires the outside experience nearly always does so on time belonging to the students. The faculty man is paid by the state, presumably for teaching, and it is easy to understand the dissatisfaction caused among engineers not so paid who must compete with the state employee. Perhaps the most serious aspect of the matter is that the teaching is left to an assistant while the professor goes after the fees. The engineer who was commenting on this practice says the cure for it is to have all fees so earned paid into the college treasury.

The Newspapers and the Business Press

The newspapers and the business press are, in a sense, competitors. They compete for the time the public spends in reading. It is well to draw a distinction between the newspapers and the business press. The former need no definition but do not confuse them with the latter. The business press includes the professional journals, technical periodicals, class publications, vocational mediums, etc., as they are variously termed.

The newspapers and the business press are on good terms. Each needs and uses the other. There is ample room for both. But, years of observation have convinced us that much time now spent in reading the newspapers should be devoted to the business press. Let any man ask himself what of value he has obtained from his newspaper reading since the signing of the armistice. He has obtained much of value, of course, but how much for the time expended? How much of value that he has obtained would have been lost to him by cutting his newspaper reading time in half? Not much. It is a stimulating and time saving exercise to see how quickly one can read a newspaper without missing an item of essential news. Today a rumor, tomorrow a denial; the time spent reading each is wasted in the end. Would it not be better for the business or professional man to cut in half his time spent in reading newspapers and to use the salvaged time in reading his business papers? Those who have tried it answer this question in the affirmative.

Design and Construction of the Monolithic Brick Road South of Seneca, Ill.

By A. H. Hunter, District Engineer, Division of Highways, Department of Public Works and Buildings, Peoria, Illinois

Illinois was keenly alive to the value of highway improvement previous to the passage of the Sixty Million Bond Issue. Even before our regular state aid came into existence, many townships and counties had expressed a willingness to proceed with improvement of roads of local importance. Actual construction, however, was not possible until ways and means had been devised to take care of the financing. With the advent of state aid, which began actual construction in the summer of 1914, it was financially possible to take up road building on roads of county importance. In cooperation with the county, aided in many instances by townships or local support, the State Highway Department of Illinois was able to improve many roads of this character.

The knowledge that Illinois is a prairie state no doubt carries with it the implication that highway building in the state would be free from serious grades or faulty alignment. Generally speaking, this is true, but naturally enough those first sections designated for improvement by county boards were those presenting the most difficult problems locally. The writer has in mind several sections in the vicinity of the Illinois river which afforded opportunities for reduction of grade and improvement of the alignment. The problems encountered, together with methods of surface construction, can probably be best described by referring to one particular section which is fairly representative of this class. I have in mind the state aid road at Seneca, LaSalle county. Generally speaking, this work consisted in improving with 15 ft. monolithic brick, 1¼ miles of winding road which extended south from the south end of the Illinois river bridge at Seneca, up the south bluff to the prairie country beyond.

Selection of the Material of Construction

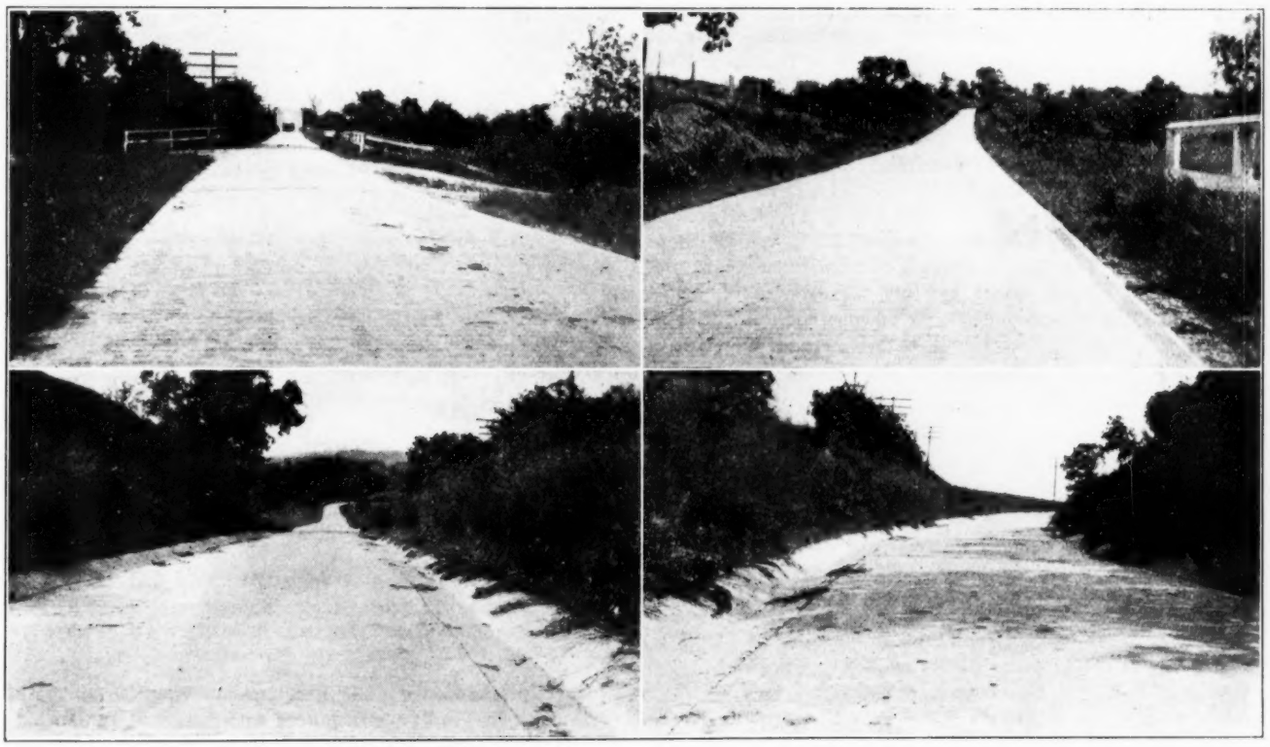
Before entering into the details of construction, I wish to state a few facts that lead up to the choice of surface. In a nearby gravel pit was found material suitable for use in construction of base for brick roads. Located in this same county is also to be found one of the largest paving brick plants in Illinois. This local situation, together with a local preference, prompted the County Board in specifying brick as the type of improvement desired.

Line, Grade and Sections

Early in the spring of 1916, surveys of the existing highway were made which in turn were used in the preparation of plans and estimates. This original survey followed the existing road, which was narrow, crooked and had a center line profile which indicated a maximum grade of 12 to 13%. In the first plan prepared, no relocation or change of alignment was considered other than improvement of the turns by standard circular curves. Again any radical change in alignment would necessitate right-of-way adjustments, which, unfortunately, our department was unable to undertake at that time.

The old grade being excessive, our plans projected a new maximum grade of seven per cent. (7%). This meant very heavy excavation on the hill. A total of more than seven thousand (7,000) cu. yds. was to be moved between stations 18 and 25. This material to be utilized to advantage in raising and widening the fill section near the Illinois river. The portion beyond the hill represented no unusual features, only the usual requirements for good surface drainage being required.

As provided in the preliminary resolution, a brick surface was planned. To meet the requirements, three standard sections were employed; one for the prairie country, another for the hill and a third for use in the fill in the vicinity of the Illinois river. The three cross sections are here shown.



VIEWS OF STATE AID BRICK HIGHWAY SOUTH OF THE VILLAGE OF SENECA, ILLINOIS.

Top Row: Surface of Brick Pavement. Also shows Guard Fence with Illinois River Bridge in Distance. This View just South of Heavy Fill Section where Protection to Traffic is Necessary—View on the Relocation with Hill in Distance. Note Portion of Guard Fence at Change in Alignment. Bottom Row: View on 7 Per Cent. Grade on Hill, showing Combined Curb and Gutter —Another View on Hill Section, showing Heavy Cut Section, Pavement and Combined Curb and Gutter.

The Hill Portion of the Road.

All work was planned as monolithic construction except in the cut on the hill. It was undesirable to plan earth ditches there, as such would be uneconomical on account of the large volume of earth excavation. Also, the hill having a 7% grade must be protected against wash in the side ditches. For these reasons, a gutter section was adopted. The 18 in. gutter on either side was to provide protection from the water. At the same time, it increased the width of pavement, really making available for traffic 18 ft. of improved surface.

Due to construction difficulties, this hill portion was planned as semi-monolithic or sand-cement bed. This type of improvement was preferred, due to simpler features of construction, the main reason being that no room was to be had in the cut for placing and culling of the brick, an all-essential operation for first-class monolithic work. By using the sand-cement bed, the base and gutters could be constructed in advance of the brick surface. When base and gutters were sufficiently hardened, brick could be stacked along the gutters, while material for the cushion could be spread directly on the base.

The bridges were simple enough—only three or four small culverts, which adapted themselves to the use of our standard culverts which are supplied by the Bureau of Bridges of our Springfield department.

With the sections adopted, a grade line was placed which had a maximum of 7%. By means of a planimeter and average end area methods, the earthwork quantities were computed. Effort was made to balance cut and fill, allowing approximately 25% excess in volume of cut to allow for shrinkage and loss in hauling. The quantities once determined, an estimate of cost was prepared, showing item by item, the quantities and estimated cost of the individual items of the proposed improvement.

The Contract

On passage of the final resolution by the County Board, which really was approval of the plans, our department called for bids in July and on August 16, 1916, entered into a contract with the Public Service Construction Co., of Omaha, Nebr. It is to be kept in mind that the State Aid Law in Illinois is such that a contract cannot be let for a figure over the engineer's estimate. A comparison of engineer's estimate with contractor's bid may be of interest first, as it furnishes a check on our method of preparing an estimate, second, these detailed figures though no longer applicable, due to vast increase and war prices, should teach us as engineers to exercise greater caution in using cost data for estimating. Although these figures, estimated cost and bid, are less than three years old, at this writing they probably are 40% or even more, below present prices for the same character of construction.

Comparison of Engineer's Estimate With Contractor's Bid

The following is a comparison of estimate to bid:

General Information.

Monolithic Brick Road	4,100 ft.
Semi-Monolithic Brick Road (Sand-Cement Bed)	800 ft.
Total length to be improved	4,900 ft.
Width of improvement	15 ft.

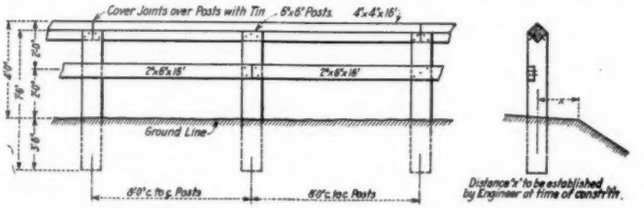
Detailed Information.

Item	Quantity	Engineer's Estimate	Contractor's Bid
Excavation in earth	9,710 cu. yds.	$3,399.00	$ 4,078.20
Borrow in earth	151	53.00	63.42
Overhaul on Earth (775 ft.)	7,809	605.00	780.90
Reinforced Concrete	26.2	286.00	314.40
Earth Shoulders	5,011 sq. yds.	150.00	350.77
Monolithic Brick Pavement	6,834)		12,300.80
Semi-Monolithic Brick Pavement	1,333)	15,822.10	2,399.40
Rip-Rap	500 lin. ft.	325.00	300.00
Concrete Gutters	1,600	754.00	1,040.00
Section Markers	2	10.00	20.00
Profit and overhead		2,492.00	
Total estimated cost of work including labor and all materials, is		$23,896.10	
Estimated cement to be furnished by State		2,237.30	
Estimated cost exclusive of cement		$21,658.20	
Contract Price			$21,647.89

(Engineer's estimate and contractor's bid are not directly comparable as cement is included in the engineer's estimate while profit is added in a lump sum. The contractor's bid for each item includes profit.)

Relocation

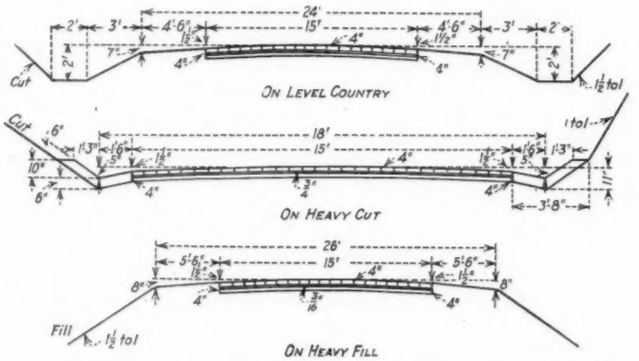
Before improvement began, township and county officials were instrumental in having arrangements made for donation



DETAIL OF STANDARD GUARD FENCE, ILLINOIS STATE HIGHWAY DEPARTMENT.

of additional right-of-way near the foot of the hill, which gave opportunity for improving the alignment. This materially reduced the angle of turn, entirely eliminating a reverse curve and added greatly to the safety of the road. In addition, the character of ground on the new line reduced the quantity of fill which was to the benefit of the contractor and, no doubt, influenced him in favor of the revised plan.

The original improvement was made possible from funds of the 1915 allotment to LaSalle county. Other work previously advanced used up the sum so that only sufficient money for improving the 4,900 ft. was available. Our contract made it possible to enter into extension work not to exceed 40% of the total cost of the original contract. As construction did not begin until September, and the 1916 allotment became available after acceptance by the county board at its September meeting, an extension from station 49 to 66 was provided at the same unit prices as submitted by the contractor in his original proposal. Consequently grading and placing of pavement began at station 66 and advanced toward the village.



THE LEVEL COUNTRY, HEAVY CUT AND HEAVY FILL SECTIONS OF THE BRICK HIGHWAY SOUTH OF SENECA, ILL.

Grading—Use of Steel Shod Wood Drag

The earth grading was placed in layers and compacted by the 10-ton roller to the height of subgrade for the pavement. This height was given by stakes of our engineer, every hundred feet, placed well out beyond the berm line of the graded road. As the excavation approached the desired elevation, it was again checked and a short stake driven to elevation of subgrade on

the center line. The resulting surface, even after the stake was reached, was rough and somewhat irregular; so much so that it would have required considerable hand work to prepare the subgrade if the usual method had been employed. In preparing this finished earth grade the contractor employed a wooden drag, cut to crown of the earth surface, shod with steel with a length about 1 ft. greater than the width of the pavement. This, operated by teams, after two or three trips, gave excellent results. The earth shoulder outside of the pavement was not graded up until the hard surface had been placed and cured.

Concrete Base

The concrete base, mix 1-3½-6, was built from local gravel of average quality, possibly somewhat high in sand, from which all aggregate over 2 in. in size had been screened. It was mixed in a batch mixer using only sufficient water to make a plastic mass. A limit on the amount of water and great uniformity of consistency must be maintained, if a desirable surface of monolithic brick is to result. This base was struck off by the standard template resting on steel forms driven true to grade and alignment. The space between front and back striking edge of the template was kept full of 1 to 3 dry sand and cement which was spread to a depth of 3/16 in. by the proper adjustment of the striker. On this the brick were immediately placed, rolled and grouted. All rolling was done by a small hand roller similar to that used on lawns. This surface was then grouted with a thin mortar and squeegeed until all cracks were filled. No excess of mortar was permitted on the bricks; also any settlement in the cracks or joints necessitated another operation with the squeegee. This finished surface was covered and kept moist, if the weather was warm, for ten days. No traffic was permitted for three weeks.

Gutter Section on Hill

The gutter section on the hill was built monolithically in regard to base and gutter. When these had cured sufficiently, the brick and sand was hauled in. On the base was placed a ¾ in. dry sand-cement bed, 1 to 4 mix, i. e. one part of cement and four of sand, struck off properly with a template. The brick was then placed, rolled by hand, swept, thoroughly wet and all joints grouted as carefully as in the monolithic work.

In the vicinity of the river the fill is from 15 to 20 ft. high and even though it was widened to 26 ft., local people desired protection. Additional work contract was arranged and our standard guard fence constructed on each side as far back as the cross road near station 5. Later, an additional 100 ft. was placed on the outside of the turn near station 7, to provide warning at the change of direction. The details of the standard guard fence are here shown. On this standard guard fence it is specified that the lower 3 ft. 6 ins. of posts be dipped in creosote. The fence is painted with two coats of white lead paint. The posts are of cedar or oak; all other lumber of yellow pine. If round posts are used they are at least 6 ins. in diameter at the small end.

At this writing the road has been under traffic for more than two years, without maintenance, and is in excellent condition.

Design and Construction of the Dixie Highway from Rockwood to Monroe, Mich.

By Leroy C. Smith, Engineer-Manager, Wayne County, Detroit, Mich.

When the United States entered the world war and turned its industries to producing war materials on an extensive basis, one of the first problems to be dealt with was the inability of the railroads to handle the transportation of these materials.

Sending Trucks Overland

This condition showed the absolute necessity of good highways over which war materials could be transported in the least possible time and at a nominal cost, time being the first consideration. Detroit began sending trucks overland about Dec. 15, 1917, and up to Oct. 1918, had sent approximately 18,000 trucks to the seaboard. This figure does not include the cars sent by the Dodge and Ford plants, which probably greatly exceed this number. Exact figures are not available.

Temporary Macadam Road

There remained between Rockwood and Monroe a part of the Dixie Highway, eleven miles in length, which had not been completed. The State Highway Department and the Monroe County Road Commissioners built a detour for this part of the road as an emergency measure. This was built of macadam on frozen ground and answered the purpose very well the balance of the winter. However, when the frost went out in the spring, this road became almost impassable and remained so until it was scarified and reshaped last August.

With this condition confronting the State Highway Department no item was overlooked so far as possible to assure the completion of the main road during the season of 1918.

Permanent Concrete Road

The labor contracts for the Dixie were let in April and May, 1918, the north 6.2 miles to the R. D. Baker Co., and the south 4.8 miles to Lennane Bros., the State furnishing all materials and the work was started at once.

Quantities Involved

The metal top is 18 ft. wide with a uniform thickness of 7 in. and 5 ft. shoulders, making a 28 ft. roadway. The grade is uniform, with no heavy cuts or fills, the country being low and level and the soil a heavy clay the entire length. The season was an ideal one for laying concrete over this type of subgrade. On the north 6.2 miles the mixer was started on June 8, and finished September 1, with only 1½ days lost on account of rain and 4 days out for moving the machine, laying a total of 67,047 sq. yds. On the south end where more grading had to be done, the laying of the concrete was finished on September 18, a total of 48,150 sq. yds., making in all 115,197 sq. yds., of pavement laid in three months. The culverts and two small bridges required about 340 cu. yds. of concrete. The total earth excavation amounted to over 43,000 cu. yds. and was evenly distributed over the entire road.

Handling Materials

Pebbles and sand were furnished by the Ward Sand & Gravel Company of Oxford and the Tecumseh Gravel Company, and although the railroad facilities are very good, the handling of the material was the real problem of the entire job. For the south end we made use of an abandoned stone quarry about 1½ miles north of Monroe on the New York Central Railroad. This furnished storage for cement, repair shop for equipment, etc. The material was unloaded from the cars with a railroad clamshell, usually direct into the industrial cars which carried it to the job, although a bin was constructed from which the cars could be loaded. A clamshell of this type can shunt its own cars and has a distinct advantage over the other type in this respect. A 1¼ yd. bucket will handle on an average of 10 carloads per day, and with an unloading capacity thus limited and the required amount of material so nearly equal to it, the bunching of cars at the point of shipment or in transit was bound to work a hardship. These conditions had to be reported at the main office, according to the Government ruling and when 20 cars or more were held 48 hours for replacement, on account of the inability of the consignee to receive them, an embargo followed. This occurred twice during the season and as 1,156 carloads of material were unloaded in the space of three months and neither job held up on account of material, we felt that the work was handled successfully.

The yard for the north end was located at Newport on the Grand Trunk Railroad, and the same method was used for unloading and conveying the material to the road.

On each job only one industrial locomotive was used. On the north end it was necessary to operate 24 hours much of the time in order to keep a safe distance ahead of a Koehring 3-sax mixer. The aggregate was mixed 1:1-½:3, with a minimum time of 45 seconds for mixing. It was sometimes necessary to increase the amount of sand to obtain the proper mix.

Joints

A ⅜-in. Carey Elastite joint was used and spaced 33 ft. No steel protection plates were used. The joints were brought as nearly flush with the surface of the pavement as possible and the belt finishing done over the joint. Care should be taken where this method is used and if the joint should settle more than ⅛ in. below the surface of the concrete, the finisher with a pair of pliers can raise them to the proper place. A sectional joint simplifies this operation and is more satisfactory in every way than the rolled joint.

Belt Finishing

The finishing was done first with an 8-in. belt and followed up with a 12-in. belt. The distance and time between the two operations is dependent upon the consistency of the mix and the weather. This method of finishing gives an excellent riding surface, the joints being entirely unnoticeable.

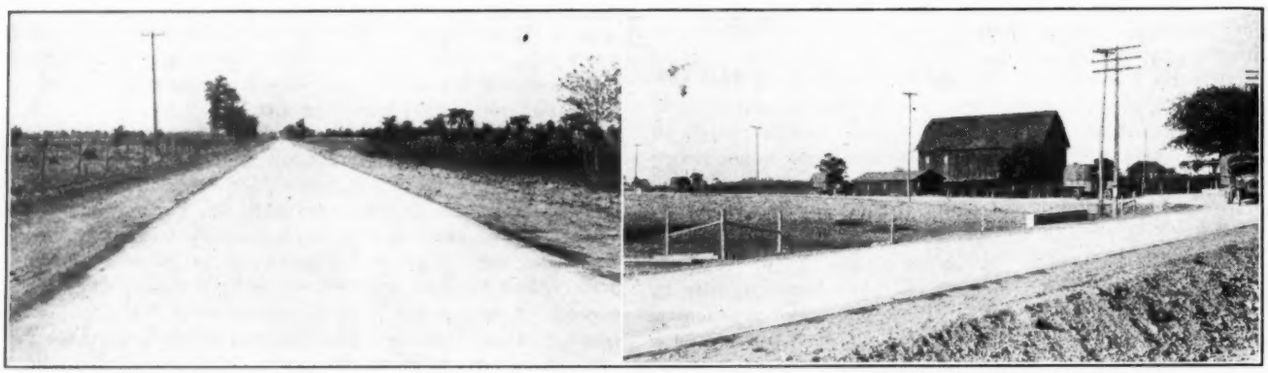
curve is approached from both directions by from 0.6 per cent. to 0.9 per cent. down grade, while the other is on a practically flat grade. Either curve can be taken with safety at 30 miles per hour, and as no claim for damages has been made, it is evident that the state speed law was not being observed.

Curing and Drainage

The pavement was cured by covering with earth and keeping the earth wet for four or five days. The drainage on this road also presented difficulties, the highest elevation being 20.1 ft. above Lake Erie mean level and the road at the nearest point, approximately one mile from the lake. At one place it was necessary to lay 1,200 ft. of 12-in. drain pipe, making a maximum cut of 7 ft., in order to get the water to an outlet. There still remain two places where outlets will have to be provided to carry the water from the highway. Steps have been taken to have this done as soon as possible.

Nearly 1,400 ft. of guard rail has been built at the corners and curves.

Where Stoney creek crosses the road, at a point 4.8 miles north of the south end, a 3-span reinforced girder bridge was built. This was let to another contractor, the material being furnished by the State. This bridge was completed Oct. 3, so that the entire road was ready for traffic Oct. 15, 1918, and was officially opened on that date.



VIEWS OF NEW CONCRETE PAVEMENT ON DIXIE HIGHWAY BETWEEN ROCKWOOD AND MONROE, MICH.

There are twelve curves which were widened and superelevated. These curves varied from 9 to 67 degrees, the two sharpest ones being 50 degrees, 40 minutes and 67 degrees 13 minutes respectively. The method used is one devised by the State Highway Department, a brief description of which follows:

Method of Widening and Superelevating Curves

Taking the P. C. of the curve, station back three stations of 25 ft. and one ahead, making a distance of 100 ft., in which the superelevation is carried out, beginning at the first station with a normal section, the outer grade line is raised to the maximum amount of superelevation, at the fifth station, or 25 ft. past the P. C. of the curve. This grade is carried to within 25 ft. of the P. T. of the curve, where the same method is used to revert to the normal grade. The amount of superelevation is governed by the radius of the curve. For radii of 66 to 101 ft. ¾ in. per foot of width, or 18 ins. The extra width of 4 ft. was added to the inside and begins 75 ft. back of the P. C., or the same point at which the superelevation started. The inner grade line should always be uniform. In case of a reverse curve or where only a short distance separates the P. T. of one curve and the P. C. of another, the extra width of metal should be continued through both curves. The inner grade line should take the form of a simple curve and meet the regular grade line about 75 or 100 ft. back of the P. C. It is apparent that only station 5 falls inside the curve and should be located as a chord of the curve, and as 10-ft. chords are used in laying out the curve, it is necessary not to confuse the two in putting on the superelevation.

Danger signs and guard rail, and at one a red light has been placed, yet several fatal accidents have occurred there. It is the writer's opinion that this is due to the fact that this

Cost

The cost of the entire job, including the bridge, will total more than $330,000, which is distributed as follows:

Proceedings	$ 49.72
Inspection	3,696.13
Freight	49,952.82
15,965 tons, 27,890 tons, 35,435 bbls. sand, gravel and cement	96,532.80
Unloading, placing material and laying concrete, grading and buliding shoulders contracts	171,388.64
	$321,620.11
Building shoulders on work done, 1917	2,500.00
	$319,120.11
Material furnished Stoney Creek bridge	5,736.10
	$313,384.01

Length of road—10.707 miles.
Cost per mile—$29,268.70.
Cost per sq. yd.—$2.72.

Highways and Railways for the Defense of Our Nation

A national defense plan requiring extensive construction and improvement of highways and railways along the borders and coasts of this country is outlined in an illustrated booklet recently issued by Sauerman Bros., Monadnock Block, Chicago. The booklet consists of an extract from a paper written

in October, 1916, by Capt. H. B. Sauerman. This plan of defense has been highly approved by engineers and army officers. It has been indorsed by some of our greatest military leaders. It is noteworthy that this paper was prepared many months before this subject was at all popular and before its importance was appreciated even by the initiated. The author suggests a defense area from 14 to 20 miles wide extending along the entire coast line and the southern border, with mobilization points from 20 to 100 miles apart.

The requisite railway and highway facilities suggested by Captain Sauerman comprise:

A double-track, private or government owned and operated, railroad connects all mobilization points. A number of the best located mobilization points are made into permanent camps for training, maneuver and target practice. The other mobilization points are simply laid out and mapped and in case of war are then put in shape for mobilization. At each mobilization point sidetracks are provided for the unloading of men and supplies. This railroad also connects with the interior railroads and highways which bring men, supplies, ammunition, etc., from the interior of the country to the different points along the coastal railroad.

From the coastal railroad, at approximately right angles toward the coast or border, single spur tracks are built at regular intervals and at the most strategic points. These spur tracks are used in time of war by the heavy rail mounted guns of 12-in. caliber and larger and for the transportation of the ammunition.

Improved highways 20 ft. wide are also built at approximately right angles to the coastal railroad. These improved highways are built from 1½ to 3 miles apart and they lead directly to the coast lines. Other improved highways are built parallel to the railroad; these highways are located from 5 to 8 miles apart. Highways in all the interior states must be improved in order that the supplies, men, etc., can be rapidly transported to the defense area in the shortest possible time.

In times of peace both the railroads and the highways will form a great commercial asset to our country and will facilitate shipping.

Copies of this interesting booklet may be obtained from Sauerman Bros. for the asking. It is attractively illustrated, showing the importance of good roads in modern and adequate national defense.

The High Service Reservoir of the St. Paul, Minn., Water Works

By W. N. Jones, Mem. Am. Soc. C. E., Mem. Am. W. W. Assn., Designing and Constructing Engineer.

Historical

For several years previous to the year 1910, it was evident that the city of St. Paul was sorely in need of extensive improvements to its water supply, but as is generally the case in municipally owned works, nothing at all was done in the matter, until necessity forced the city authorities to take some action to relieve the situation.

During the summer of 1910 an exteremly hot, dry spell prevailed over the entire Northwest and made it absolutely necessary immediately to improve and increase the water supply of the city of St. Paul. Accordingly, the late L. W. Rundlett was called in and upon his advice artesian wells were drilled at various points and fully equipped with all the necessary piping and machinery. This relieved the water shortage very materially and supplied water of very good quality, but it was extremely hard and unfit for continued industrial uses. At best these wells could only be considered as an emergency measure, as upon thorough investigation it was found that they would prove inadequate for long continued use on account of their limited water supply area. Notwithstanding these conditions nothing further was done in the matter until the spring of 1912 when G. O. House was appointed general superintendent of the water department.

Mr. House immediately reorganized the entire water department and began the study of needed improvements. Among the works contemplated by Mr. House was the construction of two additional reservoirs for storage and sedimentation, but not caring to make final decision upon such an important matter, and being very busy at the time with the distribution system in and about the city itself, Mr. House advised the Board of Water Commissioners to employ an expert in these matters and recommended Mr. Allen Hazen of New York City as the one who, in his opinion, was the best fitted to investigate and make a report upon what was necessary to be done. Accordingly the Board of Water Commissioners retained Mr. Hazen to do this work and to make such recommendations as he deemed proper to fulfill the conditions of supplying the city of St. Paul with a pure and adequate supply of water.

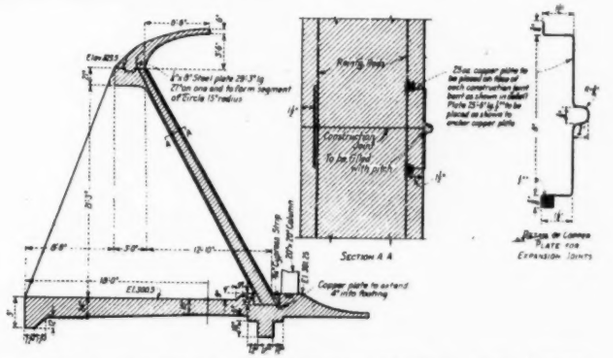


FIG. 1. SECTION OF NORTH, SOUTH AND WEST WALLS OF NEW HIGH SERVICE RESERVOIR OF THE ST. PAUL, MINN., WATER WORKS, SHOWING THE EXPANSION JOINT.

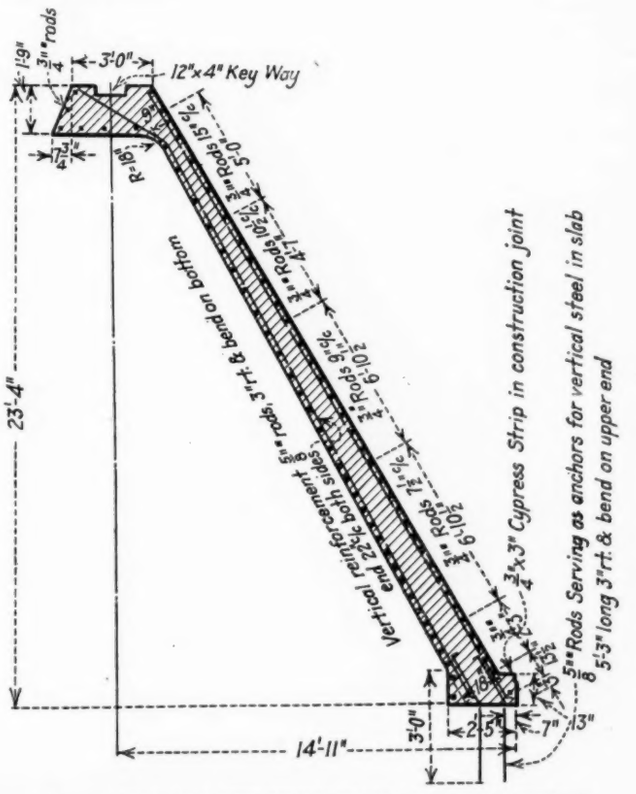


FIG. 2. SECTION THROUGH WALL SLAB OF NORTH, SOUTH AND WEST WALLS.

Recommendations Made by Allen Hazen.

The present supply, which consists of a chain of lakes, and the artesian wells, above referred to, was investigated very fully by Mr. Hazen, as was also the proposition of securing the entire city supply from artesian wells and of using the Mississippi river as a source of supply. The investigation covered fully in all details each proposition and resulted in the following recommendations:

1. That it was not feasible to take from a point near the city a permanent supply from artesian wells and that the cost of doing so and softening would be too great.

2. That the wells as already drilled and equipped should be used but seldom and should only act as an emergency reserve for use in very dry years or to help with extreme peak loads.

3. That the present system of supply from the chain of lakes should be continued, but that increased storage should

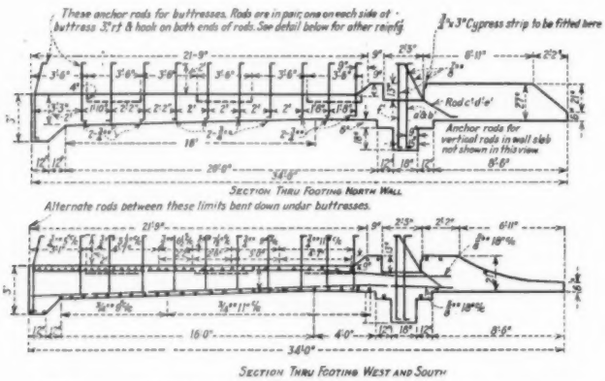

These anchor rods for buttresses. Rods are in pair; one on each side of buttress 3" rt & hook on both ends of rods. See detail below for other reinfg
1"x3" Cypress strip to be fitted here
Anchor rods for vertical rods in wall slab not shown in this view
Section Thru Footing North Wall
Alternate rods between these limits bent down under buttresses.
Section Thru Footing West and South

FIG. 3. SECTIONS THROUGH FOOTINGS OF NORTH, SOUTH AND WEST WALLS OF NEW ST. PAUL HIGH SERVICE RESERVOIR.

be provided for by building a dam across Rice creek at its outlet from Lake Baldwin, and that this storage should be augmented when necessary by pumping from the Mississippi river.

4. That the capacity of the conduit between the lakes be increased.

5. That additional pumpage capacity be installed at the main pumping station. (This has now been done.)

6. That a mechanical filter plant with all necessary appurtenances be constructed as soon as possible.

7. That a covered high service reservoir of 60,000,000 gals. capacity be built, the reservoir to be in two equal sections or parts, only one of which need be constructed immediately, the other section to be built at some future date when the consumption reached such proportions as to demand additional storage, the old reservoir to be kept in condition as a reserve, and

8. That additional mains and connections be laid as required.

Author Chosen as Designing and Constructing Engineer.

Mr. Hazen was very careful to impress upon the Board of Water Commissioners that his recommendations be followed in detail. Mr. House was, therefore, empowered to engage an engineer to design and carry on the work. He chose the writer as his designing and constructing engineer and gave him full authority to proceed with the design and construction, subject to the approval of the Board of Water Commissioners, of such parts of the entire work as was deemed most urgent and for which the water department had funds available.

Starting the Work

Much study and consideration was given to the subject and it was finally agreed that as the old reservoir was small and ill-suited for its use, a new reservoir was primarily very badly needed. Accordingly an office force was organized and early in the spring of 1916 the design of the high service reservoir was started. Keeping Mr. Hazen's recommendations and general plans for the entire work well in mind, the design was pushed as rapidly as possible and bids were asked for early in June of 1916.

At this time prices of material were showing a decided raise and although several very fair bids were received, the Board of Water Commissioners deemed it, in spite of the engineer's recommendations, wise "to take a chance" on lower prices, therefore, all bids were thrown out as too high.

Soon after this the Board, upon recommendation of Mr. House and the writer, contracted directly for all necessary piping, valves, special castings, cement and reinforcing steel and re-advertised for the construction of the structure.

The Geo. J. Grant Construction Co. of St. Paul, being the low bidder on this second bidding, was awarded the contract sometime in August, 1916, and began work on the structure early in September of the same year but to date have not fully completed their contract.

On account of local conditions and the location of the existing distribution mains, pumping station, etc., only one site was deemed available for the new reservoir. This site was of limited extent, very near and just north of the old reservoir on the top of a hill about 300 ft. above the city datum and sloping downward in all directions. As the city owned most of the top of the hill, an attempt was made to locate all the structure on city land, but this could not be done on account of the size of the proposed work and the desire to care for future extensions. After considerable study, it was decided to build a reservoir about 425x452 ft. in plan. The capacity of the new reservoir is 30,712,000 gals. with a depth of water of about 24

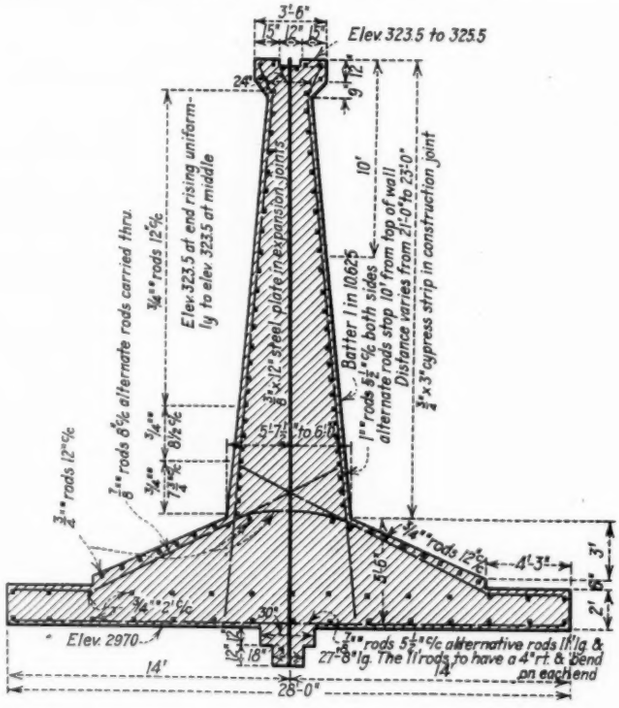

Elev 323.5 to 325.5
Elev 323.5 at end rising uniformly to elev 323.5 at middle
Batter 1 in 10.625
1"x3½" steel plate in expansion joints
1" rods 5½" c/c both sides alternate rods stop 10' from top of wall Distance varies from 21'-0" to 23'-0"
3"x3" cypress strip in construction joint
¾" rods 12" c/c
¾" rods 6" c/c alternate rods carried thru
¾" rods 12" c/c
Elev 2970
1" rods 5½" c/c alternative rods 11'lg & 27'-8"lg. The 11' rods to have a 4" rt. & bend on each end
28'-0"

FIG. 4. SECTION THROUGH EAST OR DIVIDING WALL.

ft. This necessitated the acquiring of approximately 7½ acres of additional land, but the parties owning this land refused to sell under $1,000 per acre, although land in the immediate vicinity, with improvements, was selling for $150 per acre. Condemnation proceedings were at once started and pushed vigorously through the court resulting in the award of $250 per acre for the condemned property.

Design

The customary assumptions relative to water pressures and the action of concrete and steel in combination to resist all external stresses were followed in the design. Concrete of a

1:2:4 mix was specified. All concrete was assumed to stand safely a unit stress of 650 lbs. per square inch in compression and nothing was allowed in tension. All steel was assumed to carry safely 16,000 lbs. in tension,, excepting in the large dividing or east wall, where 20,000 lbs. per square inch was allowed.

In designing the walls the concrete and steel was proportioned so as to withstand any and all stresses which they might be subjected to under any and all maximum working conditions with the reservoir full and empty, no reliance whatsoever being placed upon the earthen embankments. In other words, were the embankments removed entirely from around the structure, the concrete walls would still remain in place and perform their work satisfactorily, a condition which will actually occur when the additional capacity is being provided. Sufficient steel was placed in the inside faces of all walls to

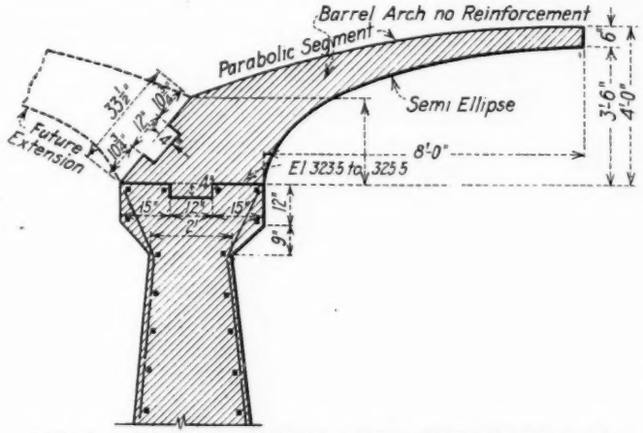


FIG. 5. SECTION SHOWING ARCH CONNECTIONS TO EAST, OR DIVIDING WALL.

withstand a hydrostatic pressure on the outside equal to that caused by a head of water equal to the depth of the point in question below the maximum flow line of the water in the reservoir. It was assumed that some leakage from the reservoir through the concrete walls would take place and that the clay embankments would naturally prevent the water from flowing away, thus reversing the stresses whenever the reservoir was rapidly lowered on account of the excessive use of water or when drained for cleaning or repairs.

The Walls

Many types of walls, especially those of the gravity and buttress and counterfort types, were investigated, both from an economic standpoint and as to stability, resulting finally in the type adopted. As will be noticed from the accompanying cuts this type depends partially upon the water for stability while the thrust of the arches is carried into the buttresses by means of a heavy reinforced concrete beam and thence into the footings where a heavy reinforced concrete slab distributes the load over the ground in such a manner as to prevent any overloading of the foundation. In order to prevent any sliding of the walls or footings on the clay below, heavy reinforced concrete beams were provided underneath the foundation slab, while the walls and buttresses were notched frequently to prevent any sliding of concrete on concrete; thus it would be necessary for the concrete to fail in shear before any movement or failure could occur at the various horizontal points.

The east wall, or the dividing wall between the new reservoir and the future extension, was designed as a cantilever gravity wall and, like the outside walls, depends partly for its stability upon the weight of water directly upon it. Provisions against sliding were also made by means of a beam dropped well into the clay below and the top was enlarged and well reinforced to care for any and all the arch thrust that could occur when the earthen embankments were removed. Provision was also made by grooving the top, to make a good and sufficient seat and bearing for the first row of arches in the future extension.

Clay Placed Under Floor

In order to prevent seepage through the subsoil, which test pits showed to be composed of sand and gravel, the design called for the excavation to be below grade and to be brought back to grade by a backfill of clayey material well sprinkled and rolled in 6 in. layers with a 15-ton roller, having at least 300 lbs. per lineal inch of tread on the main wheels. At first a layer of lean concrete about 6 ins. thick instead of the clay was considered, but upon investigation it was found that the clay blanket was much cheaper and would answer the purpose just as well. As a further precaution against leakage, wood strips, like those at Baltimore, Md., were designed to be placed between all construction joints in the footings, while all joints in the sloping walls were closed by a special copper and asphalt expansion joint.

Arches and Top Covering.

On account of the ease of construction, low cost, freedom from air pockets and rapidity of construction, inverted groined arches were designed for the column footings while groined arches with depressions in the top were designed for the vaulting covering the structure, these in turn being covered to a depth of 21 ins. above the crown with a clayey material with 3 ins. of black loamy soil suitable for the growth of grass and shrubbery on top of the whole. Past experiences in this vicinity have demonstrated that while 24 ins. of earth over the top of a reservoir does not fully protect the water in reservoirs of this type from freezing slightly, it is nevertheless adequate to prevent any damage from the action of the ice if the outside walls are also well protected. (The greatest thickness of ice has never been over ¾in.) The embankments, therefore, were not only designed to prevent leakage, but also to protect the structure from the extreme and sudden changes in temperature which occur in these latitudes, to act as a roadway around the top of the reservoir, to provide sufficient room for erecting machinery during repairs and additions and to form a foundation upon which to plant grass, etc., thereby adding to the attractiveness of the whole.

In order to provide for uniform flow across the reservoir from the inlet conduit to the outlet conduit and to prevent dead

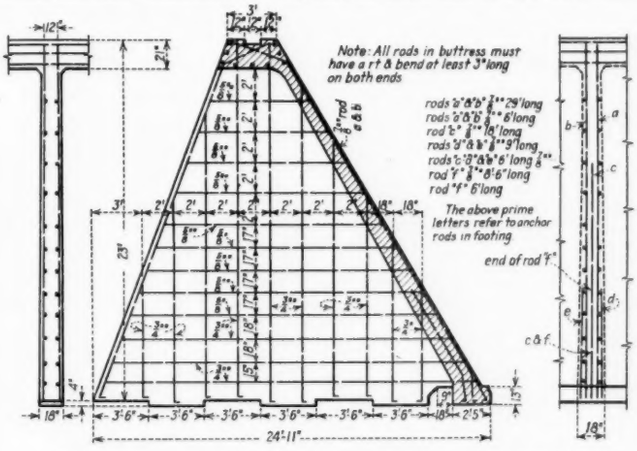

Note: All rods in buttress must have a rt & bend at least 3" long on both ends
The above prime letters refer to anchor rods in footing
end of rod 'f'
24'-11"

FIG. 6. ELEVATION SHOWING BUTTRESS REINFORCEMENT.

spaces, pinched outlets were provided. Whether these will act as contemplated is not known but as they are easily changed at no great expense it seemed worthy of a trial.

The gate chambers, which are situated, one at each end of the dividing wall, and forming a part thereof, were designed to care for an additional reservoir equal to the one being constructed and sufficient gates were placed therein to meet every demand of flexibility of operation under any and all conditions.

Aerator

To eliminate the fishy and weedy smell, which the lake

water contains at certain times of the year, more especially near the end of the summer or early fall, an aerator was incorporated in the design. The design of this aerator was based largely upon one installed and tried out by the water department four years ago with very satisfactory results. By decreasing the size of and increasing the number of holes in the plates, increasing the area of the plates and the distance between them, and by using one more plate it is thought that even better results will be obtained. In order to prevent frogs, snakes, rats, gophers, etc., from getting into the water, the aerator is to be screened in on the lower part. As the aerator is to be used for only short periods during each year, a by-pass has been provided to carry the water to it during its use, at other times the water will pass directly into the gate chambers and the aerator will be closed off and boarded up. This will make a material saving in cost of the water pumped as the cost is based solely upon the quantity and the head pumped against.

Limitation on Steel and Concrete Mix

All steel incorporated in the structure must be deformed and not square twisted, the square twisted rods being thrown out on account of the results obtained in a series of tests carried on at the University of Illinois Engineering Experiment Station, under the direction of Prof. A. N. Talbot, a description of which may be found in Engineering and Contracting of June 24th, 1914. Plain rods were not considered, although cheaper, on account of the manner in which the work might be done. It was desired that some mechanical bond be provided and the deformed bar seemed the only way of securing this result.

The design calls for no waterproofing whatsoever, as past experience has proven that a 1:2:4 concrete when properly mixed and placed will give satisfactory results under conditions similar to those which will occur in the reservoir. The spouting of the concrete into place was also prohibited as spouted concrete, especially if it has an excess of water will show air pockets. The specifications call for a reasonably water tight job such as should be expected of first class work and the contractor must guarantee the work. Should any excessive leakage take place, the contractor is required to go over the entire surface exposed to the water with a cement gun placing sufficient mortar thereon to fulfill the conditions of the specifications. (Note: The reservoir is now under test and proves satisfactory relative to leakage, etc.)

Data Furnished All Bidders

Complete data and specifications were furnished all bidders and such part of the specifications, as were deemed necessary, were especially called to their attention. For instance, the time of mixing of the concrete, 1 and ½ minutes in the drum was noted and all bidders informed that this must be done. The spouting of the concrete from the mixing plant into the forms was also prohibited and the fact called to each bidder's attention.

Test pits were dug wherever desired and samples of the different materials encountered at different depths bottled and placed on exhibition.

Information as to railroad sidings, available sites for borrow pits and spoil bank were located, analysis of different materials were made and recorded and kept open for the bidder's information.

All quantities in the structure were carefully figured, checked and tabulated and each bidder furnished a copy with a blank space for his estimate. This was done in order that each bidder would figure on the same item and quantity and as the specifications calls for unit prices on each item, every bidder was, as the saying goes, "in the same boat," thus no bidder was placed under unnecessary expense in taking off quantities and each knew exactly what he was figuring on.

Personnel

Mr. G. O. House was general superintendent of the water department at the time of the design. The writer was designing and constructing engineer in full charge of all work and was ably assisted by Mr. J. W. Kelsey, recently appointed superintendent of the St. Paul water works department, but who is now serving with the American Expeditionary Forces as captain of engineers in Germany.

Sanitary Carts and Wagons

A line of sanitary carts and wagons that is much praised by users is manufactured by Geo. H. Holzbog & Bro., Jeffersonville, Ind. These carts and wagons have closed metal bodies so they are smell-tight and cannot leak. Cities that have changed over from the practice of hauling garbage in open and leaky wagons to the use of these tightly covered sanitary vehicles are much pleased with the results now secured. The 4-wheel catch-basin wagon is also popular wherever employed. Its advantages are obvious to all familiar with the haulage incident to catch-basin cleaning. These vehicles are easily washed out, and, being of all-metal construction, do not require frequent repairs. The dump carts have circular bottoms, thus reducing corners and angles to a minimum, and this facilitates cleaning. The freedom from odor is especially appreciated by officials, as this forestalls criticisms from citizens along the collecting and hauling routes. Among those reporting to the editor their satisfaction in the use of this line of vehicles are the borough engineer of Princeton, N. J., and the secretary of the borough of Tarentum, Pa. These vehicles are supplied with either two or four wheels, for one or two horses.

Opportunities for and Data on Small Municipal Hydro-Electric Plants

By Wm. G. Fargo, of Fargo Enginering Co., Jackson, Mich.

Throughout the United States, but particularly in those parts not highly populated, but which are now being developed, there are communities quite beyond the reach of existing public or private utilities and which desire the advantages of electric service. Unless the construction of an electric power station and distribution system is undertaken by the municipality it is quite uncertain when electric service will become available to the community. No argument is now needed to convince the average American citizen of the worth

FIG. 1: OLD MILL WATER POWER PLANT REDEVELOPED FOR AN ELECTRIC STATION.

to him of electric lighting and power service for home, business and farm purposes. Here, then, is the opportunity for a progressive community to install electric equipment, supply itself and the nearby country with electric current and thus make available the essentials of modern comfort, and generally to "put itself on the map."

The Field For Municipal Ownership

The time may come, years afterward perhaps, when the little plant built by the village is in part at least approaching obsolescence, or the end of its useful life, that it may be taken over by some well organized public utility corporation with profit to the village or city, but if electric service is to be had in the meantime the surest way to start it off is for the village to promote interest and build a plant.

Where oil fuel is cheap an engine driven plant is often the most practical for small towns. In larger communities, say of 5,000 or 10,000 population and upward, with no available water power and free burning coal at fair prices, a steam plant is likely to be the most economical source of power. But where a water power site exists within a few miles of the village or city, it should be carefully considered.

Reclaiming Abandoned Water Powers

Throughout the older portions of this country there are numerous abandoned water powers formerly used for grist and saw mills and in the eastern states for small factories. Often the dams and headworks, if nothing more, still remain in fair condition and can be secured together with the rights and privileges, for reasonable sums. Taking the case of a disused mill, it is frequently possible to utilize the old water

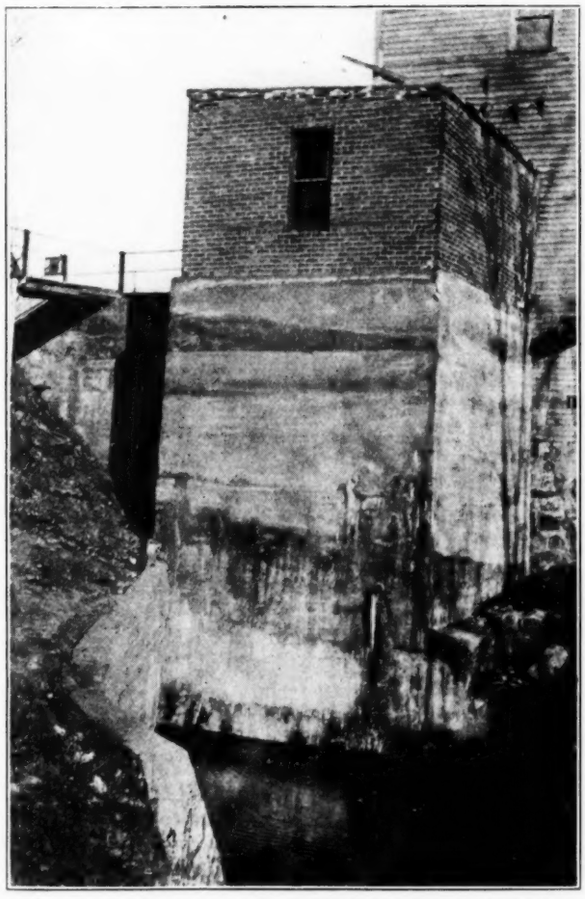


FIG. 2: CLOSE VIEW OF PENSTOCK OUTSIDE MILL SHOWN IN FIG. 1.

wheels to drive by belt an electric generator located in the mill. If the water wheels are very old, say dating back of 1875, and all of the power of the stream is needed to supply the town, then it will be best to install new equipment.

Minimum Head

It will be well to consider placing the new turbine in concrete setting outside the mill with a small fireproof house over it to contain the generator and switchboard, if a vertical direct connected generator is used, which constitutes the best and most efficient equipment. If the cheaper horizontal belted generator is to be used the turbine can frequently be located to advantage outside the mill, driving the generator by belt. A horizontal generator placed in the mill can be driven from a vertical shaft water wheel (outside the mill if desired) by means of a quarter turn belt. The pulley on the vertical water wheel shaft in such cases is of necessity large, sometimes 12 ft. or more in diameter on account of the low speeds of the larger water wheels under low heads of water. In general no head of less than 12 to 15 ft. should be considered on a small stream.

A Specific Example

In the accompanying half tones are shown an old mill power of 18 ft. head redeveloped for an electric station. Figure 1 shows the spillway in the left foreground and the mill to the right with the small square concrete penstock at the corner of the mill. The objects in locating the penstock outside the mill are first; that it makes unnecessary underpinning the mill walls to get the desired depth for the turbine discharge pits, and second; the lesser fire risk with the generator outside in a small fireproof building. Figure 2 shows a close up view of the penstock, which is about 14 ft. x 16 ft. outside dimensions and contains a 15 in. turbine developing 75 hp. at 18 ft. head, speed 400 r. p. m. The generator is 50 kw. This installation was built without much engineering advice and supervision but is a good practical installation without unnecessary features.

This little plant, with a 40 hp. oil engine auxiliary, serves three villages having a combined population of 1,150. Twelve miles of transmission line on cedar poles connect the three villages. The primary voltage of the generators is 2,300 volts and this is stepped up to 6,600 volts for transmission. Some farm customers are now supplied and more are ready to take current. The total number of services is 171 at present or 150 per thousand population served. The total investment is about $40,000, including lands, rights, equipment, transmission and distribution systems and the various assets of a going concern.

Equipment and Power Per Capita and Costs

In prosperous farming communities in the middle west where the towns are largely made up of country merchants and retired farmers, the number of services per 1,000 population will range from 200 to 250 with 225 as a fair average. In less prosperous or less progressive sections the services per 1,000 population may be as low as 100.

With about 225 services per 1,000 the station generating equipment needed will be 60 to 70 kw. or say 90 hp. per 1,000 population. This includes some auxiliary power. The cost of small low head water power plants with dams, not including transmission lines and distribution systems, at April, 1919, prices will usually range in cost from $200 to $400 per kw. installed, on a 30% to 50% load factor basis. Where a dam and mill in fair repair are available the additional cost of completing the hydro-electric development over and above the cost of the property and exclusive of transmission and distribution lines may be between $100 and $160 per kw. of generating equipment installed, including new penstock, wheel setting and generator room. Small steam plants (100 to 500 kw.) will cost from $150 to $100 per kw. and a complete oil engine plant of moderate size will cost 5 or 10 per cent. less than a steam plant of equal capacity.

Transmission and Distribution Costs

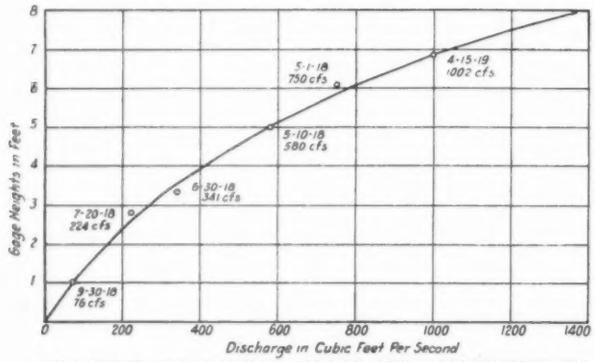
If more than one community is to be served from the same generating plant or if the source of power is some distance away from the market, transmission lines are necessary, operating usually at a secondary voltage or pressure higher than that of the primary voltage at which the current is generated. The voltage is "stepped up" from the primary pressure of perhaps 2,300 or 6,600 volts to 13,200, 22,000 or 33,000 volts by means of transformers. The higher voltages being used on the longer lines or those more heavily loaded to lessen the cost of the copper conductors. Wherever the current is to be used for power or light "step down" transformers are installed and the current is usually distributed at 2,300 volts in the larger towns and again reduced to about 110 volts for residence uses or to 220 volts or 440 volts for factory power.

Transmission lines serving country towns up to 2,000 or 3,000 population will ordinarily cost from $1,000 to $1,500 per

mile when built on the highways using 30 to 35 ft. cedar poles and No. 6 or No. 4 bare copper wire. Farm lines cost from $700 to $1,000 per mile.

The distribution systems in a series of 46 country towns in a middle west state with populations ranging from 100 to 6,000; 36 of the towns being under 1,000 population cost on an average of $51 per service or $11.10 per capita, including distribution transformers and customer's meters. The cost of customer's meters averaged about $9.50 per service. The distribution transformers averaged $9.80 per kv. a. capacity, ranging for the most part from $7.50 to $12 per kv. a. The total population for these 46 towns was 40,300.

The above transmission and distribution figures are for April, 1919 values with common labor at 35 to 40 cts. and copper wire base of about 19 cents. These costs are also essentially equivalent to an average for the years 1913-'14-'15 '16 and 1917 and are for plain substantial construction with suitable lightning protective devices throughout. To esti-



EXAMPLE OF RATING CURVE FOR DETERMINING INTERMEDIATE STREAM FLOW BASED ON SEVERAL FLOW MEASUREMENTS.

mates made up from the above figures should be added contractor's profit and any general overhead expense as for supervision, engineering and financing.

Operating Costs

For the purpose of comparing the relative cost of power produced from the three different types of plants; namely, water power, steam and oil plants, the following tabulations are presented. The figures being derived from actual cases.

(A) Water Power:—200 kw. capacity.

Head 12 ft.; drainage area 140 sq. miles; annual rainfall + or — 30 ins.; usual summer water 70 cu. ft. per second; average yearly flow 140 c. f. s. Plant capacity 250 c. f. s.—200 kw. Cost of rights, dam, plant, equipment and 4 miles of transmission line.....$47,000

This is at the rate of $235 per kw. installed. Owing to the lack of water at certain times it was necessary to consider an auxiliary source of power and a 100 kw. steam plant is estimated at $12,000

Total cost of water power and auxiliary.....$59,000

Fixed Charges: (Interest, taxes and depreciation)			
For Water Power Plant		$4,700	
For Steam Plant		1,440	
			$6,140
Operating Charges:			
For Water Power Plant		$2,300	
For Steam Plant Operators	$450		
Coal @ 6 lbs. per kw. h. and $5.00 per ton	720		
Miscellaneous	300	1,470	3,770
Total annual charges			$9,910

Assuming that this plant can operate at 25% load factor the total annual output will be 360,000 kw. h. and on this basis the cost of power delivered at the end of the transmission line will be 2.76c per kw. h.

(B) Steam Plant: 200 kw. (No other source of power)

Cost of 200 kw. steam plant complete			$20,000
Output 360,000 kw. h. annually (25% load factor)			
Annual fixed charges:		$2,400	
Operating charges:			
2 men @ $75 per mo.;	$1,800		
Coal at 6 lbs. per kw. h. 1080 tons @ $5	5,400		
Miscellaneous	1,000	8,200	
Total annual charges		$10,600	

On the basis of 360,000 kw. h. output the cost per kw. h. would be 2.94c.

(C) Oil Engine Plant: 200 kw.

Engine	$14,000		
200 kw. generator	2,000		
Installation and building	3,000		
Total Cost			$19,000
Total output 360,000 kw. h. (25% load factor)			
Annual Fixed Charges: @ 12%		$2,280	
Operating Charges:			
Oil at 10 kw. h. per gal., 36,000 gal. at 13c	$4,670		
2 operators @ $75 per mo.	1,800		
Miscellaneous, supplies, repairs, etc	400	6,870	
Total annual charges		$9,150	

On the basis of 360,000 kw. h. output the cost per kw. h. would be 2.54c.

Hence the oil engine plant will in this case be the cheapest source of power.

(D) Water Power of Greater Head and Capacity

In the actual case from which these figures are taken it is possible to build on the same stream two miles farther from the power market, a water plant of 30 ft. head (instead of 12 ft.) and 560 kw. capacity at a total cost of $120,000, including the longer transmission line, or at the rate of $214 per kw. and this plant together with a 275 kw. steam auxiliary costing $27,500, will produce yearly 1,000,000 kw. h. at the rate of 2.04c per kw. h.

Therefore if it is feasible to utilize the 1,000,000 kw. h. per year which the larger water plant with its auxiliary will produce, then this is a better proposition than the other alternatives, A, B, or C.

The additional power may be marketable at a substantial profit at some nearby town by building 10 or 15 miles of transmission line and providing step-down transformers at the end of the line at an additional cost of about $25,000 for the 15 mile line, etc. In this case the power should wholesale for at least 3c per kw. h. The factory market will also invite investigation and should yield from 3 to 4 cts. per kw. h. or better, depending upon the cost of coal or oil for fuel.

Hints on Water Power Investigation

Flow of the Stream—The yield or discharge of a stream is dependent primarily upon the amount and uniformity of rainfall throughout the year within its drainage area. Assuming an annual rainfall of 25 to 30 ins. and a porous soil underlaid by more impervious strata as clay, shale, or rock, not much fissured, the runoff or stream flow may for eight or nine months per year closely approach 1 cu. ft. per second (c. f. s.) per square mile of drainage area, with a summer mean of 0.5 or 0.6 c. f. s. per square mile.

With a rainfall of 20 ins, and a porous soil not underlaid by such strata as deliver the rainfall to the stream, the available flow for eight or nine months per year may not exceed 0.2 or 0.25 c. f. s. per square mile of drainage. Thus in the first case for a stream with 1,000 miles of drainage, the average discharge or flow for three-fourths of the year will be about 500 or 600 c. f. s. and in the second case 200 or 250 c. f. s.

The power produced by modern water turbines under average working conditions will range from 80 to 90% of the theoretical value of the water at any given head or fall. On the basis of 80% water wheel efficiency the horsepower of a stream equals the (head in feet) times c. f. s. divided by 11. Thus HP equals Qh divided by 11 and HP X 0.746 equals kw. The efficiency of electrical generators will range from 90 to 93% and of transformers about 97½%.

Owing to the great variation of flow of different streams the only safe procedure is actually to measure the water at high and low times by water current meters or floats. A float measurement may be made within 10 to 20% of the truth in any stretch of the stream with uniform cross section which is straight for a distance of about four times its width. Upon a bridge or wire stretched across the stream at right angles, mark off 10 or 20 ft. sections and time floats in each section over a measured course of 20 to 50 ft. Unless vertical weighted floats reaching nearly to the bottom are used, the surface velocity should be reduced 10% for the average throughout the depth. A gage board marked off in feet and tenths should be set at or near the measuring section and read daily. Keep a record of the gage heights when beginning to take the stream velocity measurements and when the velocity measurements are completed. After obtaining several flow measurements covering the annual range of the stream, a rating curve can be plotted and intermediate discharges determined, also a clue to those gage readings which fall below or above the range of the measured discharges.

From the formula HP equals Qh divided by 11 it is seen that the power of a stream varies directly as the fall or head. However, the per cent. loss from backwater in flood times is greater for a low head than for a higher head. Thus, with 10 ft. head and 4 ft. backwater, assuming that the upper pool is kept at a constant height, the power will be reduced to 60% of normal, while 4 ft. of backwater off of 20 ft. head leaves the power at 80% of normal. Then, too, the water wheels will work at a much reduced efficiency at any such variation in head as 40%. Moreover the speed will be so much reduced in this case as to affect materially the cycles and voltage of the generators. It is therefore important to select such a dam site as has a good head, say 20 to 25 ft. or more, and is reasonably free from backwater.

The sort of foundation soil or rock is most important. Avoid quicksand and silt. Deep clay or gravel beds make suitable foundations. In limerock country, investigate the possibility of loss of water through caverns or fissures.

Electrical Characteristics

In selecting electrical equipment the prevailing frequencies and voltages in the section of the country where the plant is to be located should be duly considered in the light of probable future interconnection. Thus while three phase current will be selected for economical transmission, if 25 cycles (or some other) is the predominating frequency in all nearby systems it will be unwise to determine on 60 cycles. Primary voltages over 6600 V. are not recommended and 2,300 volts is better practice. Likewise the interposition of step-up transformers between the generating equipment and the higher voltage transmission lines is advisable on account of the protection it affords against lightning.

Recommended Procedure in the Painting and Maintenance of Highway Bridges

By Charles D. Snead, Bridge Engineer, Kentucky Department of Public Roads, Frankfort, Ky.

No maintenance of bridges will be as effective as maintenance applied regularly each year and the necessary repairs determined by periodical inspection of the structures. Every structure, concrete, steel, wood or pipe, should be inspected at least once every year and a detailed report made upon its condition. More frequent inspections should be made of structures in a bad state of repair, while small culverts should be inspected after every hard rain. By such a system repairs can be made where and when needed. The cost of repairs will not be allowed to accumulate nor will the structure be allowed to suffer from the lack of repairs.

Classification of Structures According to Conditions

I will explain what I should do with the funds you may have available were I county road engineer in your county, and will try to suggest something helpful which may be done by everyone and which must be done if existing structures are to be preserved in suitable condition for traffic.

First—A complete inspection would be made as heretofore suggested and a complete report made of every existing structure within the county.

Second—The structures would then be subdivided into three classes: (A) Structures needing no repair or maintenance; (B) structures which must be rebuilt immediately; (C) structures which may be repaired or strengthened.

Third—The classes noted under (B) and (C) would again be subdivided, the class noted under (B) under three subheads as follows:—

1. Structures which must be permanently renewed, both the substructures and superstructures.
2. Structures in which the substructure only shall be renewed permanently and a temporary superstructure built thereon.
3. Structures in which the substructures are serviceable and require a permanent superstructure.

The bridges noted under (C) would be subdivided as follows:—

1. Bridges requiring strengthening to trusses and floor systems.
2. Bridges requiring no strengthening but new floors.
3. Bridges requiring only painting.
4. Bridges requiring partial painting and repairs to floor.
5. Bridges requiring complete repainting and new floors.
6. Bridges requiring repairs to the substructure.

Would Show Many Things

What would be the value of such a complex system of dividing and subdividing? There are many things it would show quickly. First, it would give a complete list of structures in your county with a classification which would allow the only correct distribution of the bridge fund. Second, it would show your court what was necessary on every bridge in the county during the coming year. Third, it would quickly afford a basis for estimating the money necessary for this maintenance and construction during the year and would be in such a form that it would appeal to every business man in the county because he would know you had investigated conditions. Fourth, it would emphasize the want of funds for this work. Fifth, it would outline this work for your men in advance for the year in every district and eliminate bringing the forces back and forth as these conditions were discovered or reported.

Having completed the report and an estimate of the cost of the work, it should be published in every newspaper within the county with a statement of the funds available and your policy for expending such funds in each district. Everyone would then see that the money had been allotted where needed. This is the only reason for a common pool of the county's funds in the county treasury, and the only equitable way of spending money raised by taxation.

Strengthening and Repairing Old Bridges

Only class (C) structures will be discussed under maintenance. These are bridges which are to be strengthened, painted, refloored, or upon which work is required on the substructure. This work through necessity must be handled both by force account and by contract, and it is well that we con-

sider the most important features of such work—namely, strengthening old bridges, reflooring and repainting.

The old wooden trusses if too light for modern traffic do not offer much opportunity for strengthening at an economical cost. These trusses should be temporarily repaired and their floor systems brought up to the maximum capacities of the trusses. These bridges should be posted with signs warning the travelling public against overloading. The maximum allowable load should be clearly stated on the sign. It is possible that the floor systems can be increased by increasing the number of the floor beams and stringers, or else by increasing the size of floor beams and stringers. This can be economically done at a time when the floor has been removed for stringer repair or reflooring.

Many of the light steel truss bridges can be strengthened by changing the sizes of floor beams and increasing the number of stringers so that they may be made to carry safely double or perhaps three times the present wagon or truck loading. It may be necessary to make changes in connections and in certain web members to increase the capacity, but it can be done far cheaper than rebuilding in many cases. It is far cheaper to spend a few dollars in strengthening than to allow structures to be daily overloaded and their cost of maintenance to soar. There is a certain bridge I have in mind in which it is impossible to keep the floor nailed down in place, due to the fact that the stringers and floor beams deflect so great under the heavy loads that they pull the nails.

There is a suggestion, too, with regard to strengthening bridges which may be accomplished with little additional expenditure. It is more important to be able to get your loads over a structure than it is to save time getting them over. It is possible in some cases to reduce both the dead load on a structure and to confine the moving load to the center of the bridge and thus carry over with safety greater loads. This can be accomplished by reducing the width of travel way of the bridge. The proper fences and guard rails must be installed to prevent accident or traffic from using the remainder of the structure.

Bridge Floors

The day when bridge floors 2½ ins. .to 3 ins. thickness can be economically used for modern traffic has passed. For heavy traffic the maximum span for 4-in. flooring should be about 27 ins. This span can be somewhat increased for loads of 10 tons or less, or 3-in. floor used when the spacing of stringers does not exceed 24 ins. Investigation of your bridge floors will show that few of them remain long enough for decay to destroy, but instead traffic wears them out. In replacing wooden floors, if the span is not strong enough and cannot be economically strengthened to carry a better type of floor, it is to be recommended that a 2-in. by 4-in. wooden floor be used, the lumber being laid on edge and all contact surfaces thoroughly swabbed with hot tar and cambered to shed water. This type of floor has been extensively employed on new structures and is giving complete satisfaction. I have just recently had occasion to inspect such a floor which had been down for a period of nearly 6 years, and it showed no signs of decay or wear, yet it was subjected daily to a large volume of heavy traffic, both horse and motor-drawn. The cost of this type of floor is about 50c per square foot of floor surface. In laying this type of floor on old truss bridges whose stringers in the end panels merely rest on the concrete or masonry, it will be necessary to anchor at least the outside stringers to the masonry or else the floor will lift these stringers. About one barrel of tar is required for every 30 ft. of length, if the bridge has a 16-ft. roadway.

The foregoing matter is from an address before the latest Road School conducted by the University of Kentucky.

Novel Method of Pouring Concrete Sewer in Tunnel

A novel method of concreting was employed in constructing the Glen Road section of the Moore Park drainage scheme at Toronto, Ont. The concrete sewer is laid in tunnel under a covering of 25 ft. or less. The total length is 2,812½ ft. The sewer is 4 ft. in height at the crown and 4 ft. 3 ins. in horizontal diameter at the invert, with the profile of the crown walls embodying arcs of three different radii. The minimum wall thickness is 9 ins. The method of concreting is described as follows in The Contract Record: Owing to the lack of space in the tunnel, it was decided not to pour in the conventional way from the tunnel by erecting forms little by little and placing the concrete simultaneously. The crown section would have caused difficulty and extra labor would have been involved in transporting concrete from the shaft to the heading. The contractors in view of this condition, bored post holes through the roadway directly to the sewer tunnel, each hole being in the center of an 8-ft. section. The forms were erected completely, the open end bulkheaded, and the concrete mixed at the surface of the road and poured through the post holes. With a rather soft mixture this scheme worked admirably and the pressure behind the concrete was sufficient to eliminate all voids. When the pouring was complete the post holes were filled with concrete and resurfaced with asphalt. The crown walls were poured before the invert, this being afterwards concreted and keyed to the sides. The mixture was 1-2-3, with 1 in. crushed stone.

Dissolved Oxygen As An Index of the Pollution of New York Harbor

By Kenneth Allen, Sanitary Engineer, Board of Estimate and Apportionment, New York City

Ever since the appointment of the New York Harbor Pollution Commission in 1903, a systematic attempt has been made to keep track of the pollution of the harbor water. The Metropolitan Sewerage Commission, Dr. Geo. A. Soper, president, recognized the value of dissolved oxygen determinations as a measure of the digestive capacity of the water and, inversely, of its pollution, and tests begun by the Commission in 1909 have been continued by the Board of Estimate and Apportionment of the city, of which Nelson P. Lewis is Chief Engineer, to the present time.

Significant Results

The results of these tests are very significant, said Mr. Allen in addressing the American Public Health Association, and show a surprising and persistent decline in the degree of saturation in all parts of the harbor, especially in the Harlem and Lower East Rivers. As is recognized by sanitary engineers conversant with the situation, this is a matter of considerable importance to the welfare of this great seaport, and especially to those living or owning property in the vicinity of its shores. The purpose of this article is to show to what extent the pollution of the main parts of the harbor has progressed, as made manifest by determinations of dissolved oxygen. In all, 2,342 samples were analyzed by the Metropolitan Sewerage Commission and 1,859 by the Board of Estimate and Apportionment.

Interpretation of Results

In the interpretation of results a distinction must be made between those tests made in cold weather and those made in summer. While there is a progressive decrease in the warm weather saturation the winter figures remain high throughout. Even as late as April this holds good, as will be seen from the following:

In April of this year the percentage saturation found in the Hudson River varied from 70.8% to 73.3%; in the Harlem

River from 69.8% to 79.0%; in the lower East River from 76.0 to 79.3%; in the Upper Bay from 62.0 to 77.0%, and in the Kill van Kull from 65.5 to 68.0%.

The lowest average percentage of saturation is seen to be 62% while others range up to 79%—a condition of the water that in this regard may be called entirely satisfactory.

The general conclusion to be drawn from this is that there is no danger of the development of putrefactive conditions with their attendant odors in any of the main bodies of water in New York Harbor during the cold months of the year. And, as a corollary, it follows that for an indefinite time no steps to prevent such putrefactive conditions during cold weather will be necessary. In fact, the saturation figures are so high that even fish life, which in general may be said to require about 50% dissolved oxygen, is not likely to be seriously affected. (N. B. This refers to the water of the main channels only.)

Warm Weather Determinations

The significant determinations are therefore those made during the warm months and for our purposes those confined to the months of June, July, August and September only have been compiled, the averages at certain stations being as follows:

	1909* Pct.	1911* Pct.	1913* Pct.	1914 Pct.	1915 Pct.	1916 Pct.	1917 Pct.
The Narrows	83	76	69	68	78	63	63
Upper Bay-Robbins Reef	67	72	66	71	72	64	50
Hudson River	72	62	57	50	43	46	42
Harlem River	55	42	29	30	28	24	22
Upper East River	86	69	..	50	..	..	47
Lower East River	65	54	43	40	33	26	29

*A few of these were tested between October 1 and June 1.

The data show graphically the general increase of pollution in the harbor, stated roughly, we may say that in the Harlem River and the East River there is but half as much dissolved oxygen in summer as there was in 1909, and in the rest of the harbor but about three-fourths as much as in that year. The increase in population during this period directly tributary to the harbor (omitting New Jersey), which is the chief contributing factor in the depletion of oxygen, is shown in Table I.

TABLE I—ESTIMATED POPULATION OF NEW YORK CITY DIRECTLY TRIBUTARY TO CERTAIN BRANCHES OF THE HARBOR

	1909	1917	% Increase
Upper Bay and Narrows	526,000	712,000	35
Hudson River, Lower	711,000	855,000	20
Harlem River	620,000	833,000	34
Lower East River	2,107,000	2,709,000	28

Minimum Saturations

Now, while odors may occur with the discharge of large volumes of septic sewage or by the generation of gas bubbles by fermentation of the underlying sludge, they are not produced in polluted water until the dissolved oxygen is entirely used up. The change is then rapid to the putrefactive stage with its repulsive odors. The importance of avoiding this condition is evident, and it follows that minmum saturations are of prime significance. These, for several points in the harbor, are given in Table II.

TABLE II—MINIMUM DEGREE OF SATURATION WITH DISSOLVED OXYGEN OBSERVED AT CERTAIN STATIONS IN NEW YORK HARBOR

	1909 Pct.	1911 Pct.	1912 Pct.	1913 Pct.	1914 Pct.	1915 Pct.	1916 Pct.	1917 Pct.
The Narrows	65	62	61	43	45	54	48	46
Robbins Reef	62	64	53	38	70	58	51	42
Hudson River—								
Pier "A"	57	49	51	25	31	25	29	25
155th St.	55	57	..	..	36	22	25	20
Spuyten Duyvil	55	68	..	50	64	35	28	..
Harlem River—								
Morris Heights	..	46	..	..	6	8	..	1
Willis Avenue	54	29	..	..	0	6	1	0
Lower East River—								
23rd Street	52	..	..	39	28	19	8	10
Pier 10	52	49	49	13	19	22	17	19

Conclusions

As the worst conditions naturally occur near sewer outlets and at other points near the shore where currents are retarded and where deposits of sludge have formed, we may infer from these figures that:

a. The conditions in the Lower East river and the Harlem river are such that local nuisances from foul odors may be looked for at any time after several days of very hot weather.

b. The conditions in certain parts of the Hudson river and of the Upper East river are approaching those that already obtain in the Lower East river.

Some Specific Suggestions on the Drainage of Roads

An essential feature of an improved road is adequate drainage, according to the specialists of the Bureau of Public Roads, United States Department of Agriculture. Thorough drainage is so necessary that it is practically impossible to maintain satisfactory roads unless it be given proper attention. Another prime requirement wherever a hard surface road is to be constructed is a firm and unyielding foundation. As the quality of the soil has an important influence on the proper method of drainage and the type of foundation to be employed, much care and study must be devoted to the nature, type, and character of the soils in the section through which it is proposed to build a road.

The most important primary soils are classified as gravel, sand, and clay, but often many of the secondary or mixed soils, because of their more general occurrence in connection with road-building operations are equally important. Such types as loam, marl, gumbo, and hardpan are representative of this order.

Drainage Structures

In the design of a road the drainage structures are planned to take care of water and under three general conditions—rain that falls on a road surface or grade; rain that falls on contiguous land and grows in accumulated volume towards the road; and ground water from any immediate source. To meet these conditions use is found for special structures, including longitudinal side ditches, usually parallel, or approximately parallel to the center line; intercepting ditches to accommodate water whose approach so close to the roadway as the side ditches is likely to cause injury; lateral ditches or culverts to conduct accumulated water away from or under the road; and subdrains. In order to plan intelligently a system of drainage for any particular road, it is necessary to consider not only the local character of the soil composing the roadbed, but also the topography of the adjacent land, the amount and rate of rainfall and the availability of material suitable for use in constructing drains.

Provide Surface Drainage Systems

Surface drainage systems for roads consist of side ditches along the road, paved gutters (which are a development of side ditches and replace them) open intercepting ditches constructed to prevent water from reaching the road, and lateral or relief ditches to carry off the water which collects in the side ditches or in the intercepting ditches. Culverts and inclosed drains, which are constructed for the purpose of removing storm water from the side ditches or gutters, are essentially a part of the surface drainage system, and are not to be confused with subdrains which serve an entirely different purpose.

Where the grade of a road is so steep that the ordinary earth side ditches can not be maintained satisfactorily at a reasonable cost, or where earth side ditches would be insanitary or appear unsightly, it is customary to provide paved gutters for removing the surplus water. The point at which it is economical to change from earth side ditches to paved gutters on account of the steepness of the grade depends on the character of the soil and the amount of water to be carried.

Gutters

Gutters may be constructed of Portland cement, concrete,

brick, cobble stones, angular fragments of stone, or other material. In some cases they are formed simply by constructing a curb along the edge of the road surface, as is done sometimes in city pavement construction. This method can be employed only where the road surface is made of material capable of withstanding the eroding action of water and where it is not important that the earth shoulders be kept open to vehicle traffic. Gutters are made from 2 feet to 6 feet wide and from 3 inches to 10 inches deep, depending to a great degree on the type of design, and the size is governed by the same consideration as governs the size of earth side ditches; that is, they should have a cross section sufficient to drain the road without danger of overflow, and in order to determine this cross section it is necessary to consider the area drained, the maximum rate of rainfall and run-off and the character and slope of the gutter.

Inlets and Catch Basins

Drop inlets and catch basins are used to conduct water from side ditches or gutters into under-ground drains or culverts. On country roads they are used most frequently on side hill locations where the water collecting in the upper side ditch or gutter can be removed from the road at intervals by means of a culvert across to the lower side. Drop inlets usually are sufficient, and catch basins seldom are used in country road work, except where it is especially desirable to prevent the silt and other foreign material carried by the water from getting into the underground drainage structure.

Open Ditches Used in South

Open ditches have been used frequently in some of the Southern States for subdraining roads through low, flat sections. Ordinarily only one ditch is used, and it is located a few feet outside of and parallel to the road. This ditch usually is made about 2 ft. wide and 3 to 4 ft. deep, with vertical banks. The material excavated from the ditch is used to build up the roadbed, and the surplus water from the side ditches is turned into the deep ditch at convenient intervals. The use of such ditches should be decided upon with care. There are ditches in the South, within the coastal plain, where sand clays and indurated clays occur a few inches underground that have stood with vertical sides since the middle of the last century. They have been cleaned repeatedly and no doubt have become somewhat enlarged, but considering the cost of maintenance and the service given, they have been entirely satisfactory. In other soils of a gravelly nature, however, the sides of such ditches would not stand, and the cost of keeping them clean would be excessive. In certain localities the open ditch soon will become obstructed by the banks breaking away and by the growth of vegetation, and is very seldom economical in the long run.

Filled Ditches

Ditches filled with broken stone or gravel sometimes are used as a substitute for tile drains. These have been used in all sections of the country, and when properly constructed usually have proved satisfactory for a considerable period of time. When such ditches are used it is common practice to place one on each side of the road immediately under the ditches. They are excavated to a depth of 2 to 3 ft. with vertical sides and usually are made about 18 ins. at the top or just wide enough for a man to work in them conveniently. To be effective they must have a uniform grade and be carried to a suitable outlet.

Tile Drains

Tile drains in general are much superior to either open ditches or ditches filled with stone for subdraining roads, and though generally more expensive than either open or stone drains, they usually can be constructed at comparatively small cost. As a rule the tile need never be over 6 ins. in diameter, while for ordinary conditions a diameter of 4 ins. is sufficient.

Firm Foundation Essential

The purposes of a foundation are to aid in distributing the pressure due to wheel loads concentrated on the road surface, so that the intensity of pressure on the subgrade will not exceed a safe unit-bearing power, and also to prevent, if possible, the crust of the road from being disturbed by the upward pressure of the subgrade due to the action of frost, ground water, or other disturbing influence. In the case of a pavement consisting of comparatively small blocks, such as vitrified brick, bonded to each other very slightly or not at all, an entire wheel load might be concentrated on only a few square inches of foundation, in which case it would be necessary for the foundation to take care of practically the entire distribution of the load. On the other hand, a monolithic pavement, or a pavement in which the individual units are well bonded together, might distribute the wheel loads to obviate all necessity of further distribution by the foundation, and if adequate drainage were provided and there were no danger of heaving of subgrades, the foundation might be omitted entirely.

Maximum Wheel Loads

The heaviest vehicle that ordinarily has passed over a public highway heretofore is the 15-ton traction engine. Such engines are so designed that the rear axle carries about two-thirds of the total weight, which arrangement gives a concentrated pressure on the road surface of about 5 tons under each rear wheel. The use of much heavier equipment is in sight, however, and unless some regulations be passed to prohibit it, the occurrence of 10-ton or even heavier motor trucks may become common on highways adjacent to large cities or between large centers that are only a few miles apart.

In assuming the maximum wheel load for any particular road a reasonable allowance should be made for future increase. Since motor trucks have come into use there has been a constant tendency to increase both their rates of speed and the loads they carry, and it is probable that this tendency will continue. Furthermore, many roads not now subjected to motor truck traffic will attract such traffic after they are improved, and this possibility always should be considered. Increase in the volume of traffic also may be an important factor, because a foundation ample to support an occasional load might fail soon if the same load were often repeated.

Procedure in Constructing an Open Joint Wood Block Pavement at Toledo, Ohio

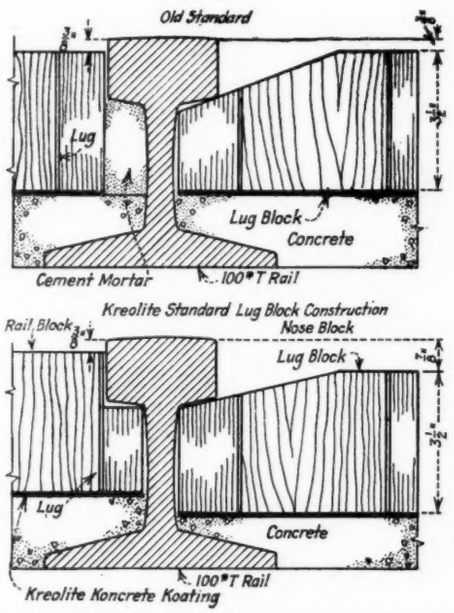
By Raymond Pierce, Construction Engineer, Russel & Jennison Co., Toledo, Ohio

The city of Toledo, on August 17, 1917, awarded a contract to the Russell & Jennison Co. to pave Dorr street with about 40,000 sq. yds. of Kreolite lug wood block. Delay in signing the contract prevented the work commencing until September.

VIEW OF DORR ST., TOLEDO, OHIO, AFTER PAVING WITH KREOLITE LUG WOOD BLOCK.

Because of an extraordinarily early winter, snow setting in on the 12th day of October, and the continuously bad weather thereafter, the work was delayed to such an extent that not much was completed before spring.

In order to carry on the work during the winter months, it was necessary to use a tractor to steam the stone and sand and to furnish hot water for the concrete mixer. The concrete was laid in this way during the winter months and covered with straw until the thermometer registered about 20 degs. above zero.



OLD AND NEW STANDARD WOOD BLOCKS ADJACENT TO RAILS, DORR ST. PAVEMENT, TOLEDO, OHIO.

On 2,100 lin. ft. of this street, an old Medina stone pavement, which had been laid upon a sand cushion, was taken up and replaced with a 6-in. foundation of concrete. Upon this 3½-in. Kreolite lug blocks were laid over a ½-in. cushion of sand-cement mortar. The interstices of the blocks were filled about one-quarter full with fine, dry sand, the balance being filled with hot pitch. The remaining 7,500 ft. was originally an old asphalt block pavement laid upon a 6-in. natural concrete foundation. Because of the poor condition of the concrete on this section, it was decided that the worn places or holes should be thoroughly cleaned and brought to the proper grade with new concrete.

The crown of the street was changed from 6 to 4 ins. and 2½ ins. of new concrete was placed over the old 5½-in. natural cement concrete foundation. The new concrete topping was struck off with a template, floated with a Ransom concrete roller and finished smooth by hand with an ordinary wooden float. This surface was then allowed to dry for seven days and a very thin mop coating of pitch was applied, with Kreolite lug block laid directly upon the same after allowing the pitch to harden.

Filling Joints

On about 2,200 ft. of this section the interstices were filled with about ¼ in. of fine, dry sand, the balance being filled with pitch. Fifty-three hundred feet of this section had the interstices of the blocks filled with sand about two-thirds full, the remaining one-third being filled with one application of hot pitch.

In the pitching of the joints the best results were secured by the use of a squeegee made with a ½-in. strip of pure gum rubber.

Paving Car Tracks

About 3,000 lin. ft. of the car tracks were laid with a 7 in. concrete base upon which were placed 6x8x7 untreated oak ties on 2½-ft. centers. One-hundred-pound American Railway Engineering Association rails were used on this work. Upon this concrete base and under the ties was tamped 3 ins. of crushed stone. After thoroughly tamping the stone, an additional 6-in. concrete foundation was laid, which was given a smooth finish and a coating of pitch, directly upon which were placed 3½-in. Kreolite Lug Wood Blocks, the wearing surface of the blocks coming ⅞ ins. below the inside of the head of the rail and ⅜-ins. below the outside of the head of the rail. About ¼-in. of dry sand was then applied as a filler to act as a dam to prevent the pitch from floating the blocks, and the balance of the interstices completely filled with pitch as above described.

Concave Track Paving

An unusual feature of this construction was that instead of crowning the wearing surface between the rails and between the tracks, as usual, the finished roadway was concaved ¾-in. to permit the water to run more readily away from the rails to the center of the tracks or dummy.

The remaining 6,600 ft. of tracks was laid with steel ties as manufactured by the International Steel Tie Company of Cleveland, Ohio. Six steel ties were placed to every rail in the tracks and the ties electrically welded to the rail. The bolts were all spotted at the nut to avoid working of the joints. The track was then placed in an 18-in. concrete foundation, finished smooth and the blocks laid as above described.

The Nose Block Used

On this section of track 3,400 ft. were laid with the old style nose block, and 3,200 ft. with the new style Kreolite lug nose block as shown in the accompanying drawing. It will be noted that the new style nose blocks were placed ⅞ ins. below the top of the inside head of the rail, while the old style nose blocks were placed ⅜ ins. below the top of the inside of the head of the rail. It was found that by placing the new style nose blocks in this way, the trouble caused by the flanges of the heavy interurban cars reaching out and cutting the ends of the blocks was eliminated.

Fifteen hundred feet of double track were laid with Kreolite rail blocks. These rail blocks were found to give very excellent results on the outside of the outside rail and on both rails of the dummy, in avoiding the possible working up of the blocks alongside the rail.

Handling the Filler

Considerable trouble was experienced during the summer of 1918 because of the bituminous filler being applied too heavily the fall previous. When warm weather arrived the pitch became obnoxious and it was necessary to sand the pavement several times. The engineers in charge of the construction immediately cut down on the amount of pitch used on the balance of the pavement, increasing the quantity of sand first applied to the interstices as a dam, to a depth of about 2½ to 3 ins. and filling the balance with pitch. This method of construction caused trouble from obnoxious exudation to cease.

Because of the heavy application of the filler, in a few instances the blocks first laid "floated," particularly along the car rail. This is a strong argument against the application of too much filler. It demonstrates the necessity of first placing a sufficient dam of dry sand to prevent the possibility of the pitch geting underneath the blocks.

With this new method of construction, blocks are first firmly keyed to the smoothly finished concrete foundation and it is impossible for the sand filler, which is first applied, to affect or disturb the permanence of the cushion.

This open-joint method of construction not only waterproofs the surface of the pavement by the application of the pitch filler, but also waterproofs the under side of the blocks, thus thoroughly sealing each individual block of the pavement on five sides, transforming a multiple into practically a single unit pavement. The coating of sand which is finally applied to the pavement is ground into the upper fibers of the blocks and interstices between them.

A Review of Modern Steam Shovel Practice, with Recommended Procedure

By Capt. Llewellyn N. Edwards, Supervising Engineer of Bridges, Toronto, Ontario

Modern methods of earth excavation are sometimes said to have originated in war—in the building of the Roman military highways and fortification for the defense of all parts of that ancient, world-conquering empire.

While these works were doubtless among the most important activities of the Roman military engineers, it will be admitted by any one who gives this matter careful consideration that the claim mentioned above is at least far-fetched. In so far as Canadian and American practice is concerned, it must be recognized that our most modern methods represent a consistent development of less than half a century, and nothing could be more certain than that it has been very closely allied with the enormous strides made in the methods of transportation—from the horse-drawn vehicle to the high-speed steam locomotive and the electric and other motors.

Capacity Doubled in Two Decades

No doubt one of the most important factors in modern methods of construction has been the development of the power-driven excavator commonly known as the steam shovel, although this term is more or less a misnomer, since many of these machines are operated by electric power. This development has been measured by the requirements of their use, and has kept step with the constantly increasing demands of economy and efficiency. In this connection it is especially interesting to note that within the last two decades the operating capacity of the largest shovels has more than doubled. This increase, although rapid, has been gradual and at all times amply justified by previous practice.

Experience has fully proved that whatever is feasible or desirable from a commercial or economic standpoint can be built from a mechanical standpoint. It follows, therefore, that the limits of the size of a shovel are dependent upon the magnitude of the work it must perform to insure its profitable employment, and upon the facilities available for the disposal of the excavated material.

The various types of shovels are dependent for their characteristic features upon the classes of work for which they are designed. Steam shovels are now mainly employed upon excavations incidental to the construction of railways, highways, canals, sewers and ditches, in quarries and mines, and in the making of excavations for bridges, buildings, etc. However, there is an ever-growing field of usefulness, and from time to time work requiring special features of design and adaptability are coming into view.

Fixed or Rotating Bodies

1. Those having a fixed main body, upon one end of which is installed a boom and dipper so arranged as to be capable of being swung horizontally through an angle varying from one-half to two-thirds of a complete circle, the angle of swing being mainly dependent upon the construction of the jack-frame of the shovel. The remaining portion of the fixed body is equipped with the operating machinery, power plant, etc.

2. Those having the entire shovel body mounted upon a turntable, which renders it possible to rotate the body, including the boom and dipper, horizontally through a complete circle, the boom having no horizontal movement independent of that secured by revolving the main body of the shovel.

Shovels used for railway construction work are almost invariably built to standard gage and are equipped with air brakes and other standard appliances necessary for coupling them into freight and work trains.

Wide Tread Wheels Preferred

Shovels used for highway, canal, sewer and other ordinary work may be constructed with trucks, which adapt them to movements upon standard steel rails, or they may be provided with wide tread traction wheels. In general the latter are preferred, since the wide tread wheels are best adapted to varying soil conditions.

Economy and efficiency of shovel operation are mainly dependent upon a properly proportioned combination of the latent power of the machine with the brains and experience of the operator. Broadly speaking, shovel operation may be divided into two phases:

1. The movement of the entire machine longitudinally, transversely or otherwise, as the physical requirements of the work may demand.

2. The manipulation of the dipper and boom incidental to the actual excavation of the material.

Assuming that transportation facilities by cars, wagons or other means are ample for the removal of excavated material to the full working capacity of the shovel, and that this service is as nearly continuous as possible, the output of the shovel is mainly dependent upon (a) the efficient operation of the dipper and boom and (b) the movements of the entire machine incidental to the enlargement of the excavated area.

Moving the Shovel—Horizontal movements of the shovel are accomplished in several ways. The importance of making the "move up" in the least possible time is far too frequently underestimated. However, the thoroughly efficient shovel operator fully realizes its relation to the total excavated yardage handled in a given length of time.

Movements on Rails—Whenever the shovel is to be transported comparatively long distances under its own power, the simplest form of track outfit consists of short sections of rails spiked or bolted upon wooden sills or stringers. The rails are maintained at proper gage by means of eyebolts and cramps. Details of this form of track section are shown in Fig. 1. Increased distribution of the wheel loads is generally provided, when necessary, by the use of transverse "mud sills" placed at intervals under the rail sills. The safe movement of a shovel down a grade requires that the track sections be secured

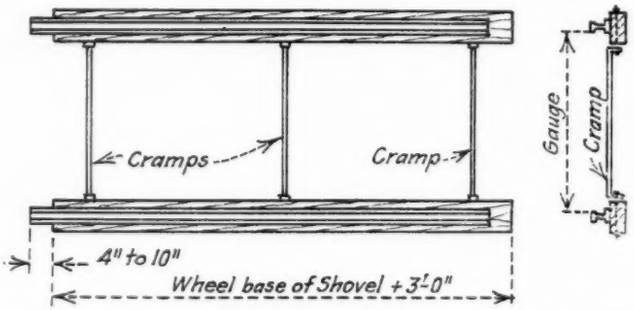


FIG. 1. TRACK SECTION FOR LONG DISTANCE MOVEMENTS.

against longitudinal movement by the use of rail splice plates or other appliances.

Economy effected by the use of track of this type, as compared with track of ordinary construction, is readily apparent.

To facilitate the "move up" of the shovel in the operating pit, somewhat shorter sections of track than those shown in Fig. 1 must be used. The length of rail is somewhat dependent upon the size of the shovel, but in general it should be equal to the length of the average "move up" distance.

Very Useful Track Section

The track section shown in Fig. 2 is well adapted to a wide range of service conditions. The joint ties perform a two-fold function—the elimination of splice plates and bolts and the distribution of the wheel loads over a considerable area. The rails are held in place by the rail clips and coupling pins. The holes in the rail clips should be slightly slotted to facilitate the engaging of the holes in the rails.

Movement of joint ties is facilitated by the use of hooks or

other specially devised carrying devices, for which purpose eye-bolts are provided in the ends of the ties.

Movements on Wooden Skids—Movements of the shovel on a wooden track are adapted to the use of shovels equipped with traction wheels. Usually the track consists of a double course of planks or lagging, the upper course of which is laid longitudinally or workwise with the direction of movement of the shovel. These are commonly called "running planks." The lower course of planks is laid transversely to the upper and serves to distribute the wheel loads on soft or uneven ground.

The upper and lower course planks may be used as detached pieces or they may be assembled into built-up track sections, as shown in Fig. 3, for use in conjunction with the shovel of the turntable class.

Whenever built-up sections are used, they are moved to and from their location in the track by being lifted upon the dipper arm, a sling chain being provided for this purpose. Doubtless the most important factor upon which the successful lifting, swinging and dropping of the track sections into correct position depends, is the expertness of the shovel operator. However, this is a detail in which a careful operator should be able to attain efficiency by a comparatively small amount of practice.

Tough, Hard Timber Required

The timber used must be tough and comparatively hard. The former property prevents splitting, while the latter facilitates "skidding" of the wheels when turning the shovel or changing the direction of the cut.

Movements without Track—Shovels of light weight having traction wheels are occasionally operated without the use of track. In general the two conditions under which such operation may be undertaken are:

1. Upon a pit bottom consisting of a naturally cemented gravel or sand, shale-like clay or other exceptionally firm material.

2. Upon a comparatively firm pit bottom and with a shallow cut, rendering a "move up" necessary at short intervals.

Competent pit men contribute very greatly to the effective and satisfactory moving and operating of the shovel. One of their most important duties is the proper leveling and compacting of the pit bottom preparatory to the laying of track sections for the "move up." If this work be improperly done, the track will take an irregular bedding, which tends to increase the wear and tear upon the track sections, and also, by reason of track deformations, produces irregularities in the working functions of the shovel. A hardpan or a broken-stone pit bottom involves a quite different class of preparation from that composed of soft, yielding earth, upon which an allowance must be made for settlement and possibly for localized soft spots.

Turning the Shovel—Turning movements are commonly effected by a series of forward and backward movements, by which the alignment of the shovel is gradually changed to conform to the desired alignment. Railway and other shovels moving upon steel rails are deflected from a previous alignment by the use of curved track. Shovels equipped with traction wheels change direction by the use of a steering appliance which swings the forward wheels in the direction desired for any given movement.

Revolving shovels mounted upon traction wheels are equipped with the steering appliance mentioned above, but shovel operators quite frequently prefer to alter the alignment of the shovel by a series of sliding movements, commonly known as "skidding the shovel," in which the entire machine is swung about by a slight longitudinal movement. Possibility of breakdowns or unlooked-for accidents is not appreciably increased, provided the movement is executed with reasonably good judgment and care.

Skidding and Its Advantages

When a shovel is placed in proper position for "skidding" a rear wheel is trigged to prevent a forward movement and the other wheels are free to move both forward and sidewise. The dipper is thrust vertically downward and takes a firm, even bearing upon the pit bottom, the dipper arm being subjected to a slight pressure, which has the effect of tending to raise the boom.

Immediately upon the completion of the above preparation, the shovel is subjected to a combined swinging and traction effort. The shovel body is swung slightly. This movement, combined with the forward tractive effort, subjects the vehicle portion of the shovel to a thrusting force, which produces a lateral slipping of the nearest front wheel and a combined lateral and forward movement of the wheels on the opposite side of the shovel. The nearest rear wheel executes a slight pivotal movement, but, being trigged, remains otherwise stationary.

Turning the shovel by this method possesses three advantages especially worthy of mention:

1. The area required for the execution of the movement is small in comparison with that required for a movement involving the use of the steering appliance.

2. The time and labor elements are reduced to a minimum.

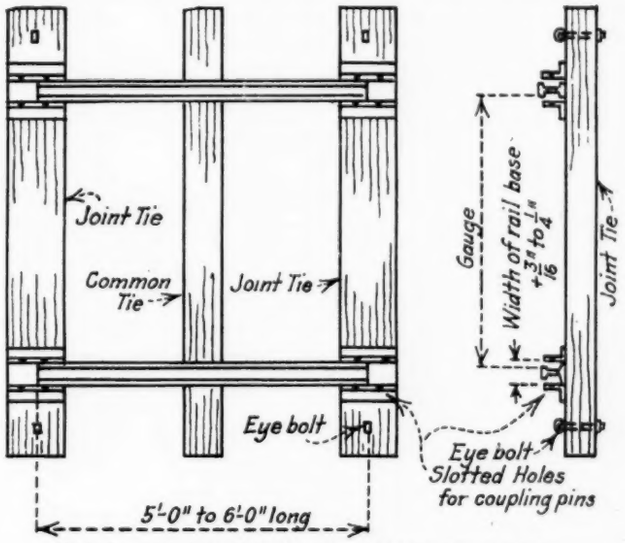


FIG. 2. TRACK SECTION FOR MOVE-UP IN PIT.

3. The excavation of material is continued throughout the execution of the movement at a rate only slightly reduced below normal.

Dipper and Boom Operation

The composition, physical properties, etc., of the material to be excavated constitute important factors entering into effective dipper and boom operation. A brief consideration of natural soils, including rock formations, is therefore essential to a discussion of the functions affecting the efficient operation of these members.

Broadly considered, natural soil materials are divided into five general classes: Rock, gravels, sands, clays, and ordinary soft soils and earths.

Rock varies in its physical properties from the granites, syenites and other hard crystalline rocks, to the sandstones, conglomerates, shales and other comparatively soft rocks of sedimentary origin. Rock formations must geenrally be broken into comparatively small fragments by blasting before they can be excavated with a steam shovel. However, very soft sandstones, conglomerates, shales and other rocklike material commonly known as "rotten rock," can frequently be excavated without blasting.

Gravels vary widely in composition and texture. A coarse gravel firmly cemented with a natural earthy cement containing iron, lime or other cementing material, may require to be blasted before being excavated; while on the contrary, a loose, disintegrated gravel may be freely excavated without previous preparation.

Sand-like gravel varies widely in composition and texture. It may exist as hard, practically cemented material or, when saturated with water, as a soft, unyielding, semi-fluid material.

Clay varies in its physical composition from that containing a considerable amount of fine, sandy material to that which is commonly known as "gumbo," in which there is no sand. It may exist as a firm, solid material of great cohesion and density, closely resembling shale rock, or as a pasty, semi-fluid material which will squeeze and ooze under pressure.

Soft soils and earths commonly contain vegetable matter. Swamp deposits of peatlike soils are almost entirely of vegetable origin.

From the above consideration of the diversified character of natural earths, it is clearly apparent that the operation of the dipper and boom is especially exacting, demanding the closest attention and skill on the part of the operator. The operation of the dipper involves two primary movements:

(1)—A thrusting, commonly termed "crowding," movement by which the dipper is forced into the material; and

(2)—A vertical or lifting movement by which it is drawn through the material.

To these may be added a horizontal swinging movement, which is secondary in its nature, since it is produced by a swinging movement of the boom rather than by the dipper-operating machinery. The thrusting and lifting movements are almost invariably applied simultaneously.

A fully loaded dipper accomplished by the least possible effort and in the least possible length of time is the primary object sought by the operator. To this end he directs all dipper movements. However, the magnitude and the speed of the thrusting and lifting movements are influenced to a marked degree by the physical character of the material. A dense, hard and uniformly firm material (for example, a shale-like clay) can be successfully excavated only by a comparatively slow thrusting and lifting movement, giving sufficient time for the fracturing of the material. In comparison, a very tough but comparatively soft clay "cuts like butter" when the dipper is operated to "peel it off" in thin slices.

Rock, when well broken by blasting, involves no special consideration apart from that adapted to ordinary materials. Rock excavation from which large irregular fragments must be removed, demands a rather different treatment. These fragments must be adjusted in a manner which will permit them to pass through the dipper when delivered or, if too large to permit this, they must be so poised upon the dipper teeth as to permit of their removal with the least possible effort and loss of time.

The above conditions can be most effectively met by the operator who by using a certain amount of foresight aims to load each dipperful in a manner which will prepare the way for securing a succeeding dipperful. By the exercise of good judgment, the large fragments are thus shifted about to positions from which they are caught within or upon the dipper with least difficulty and effort and with practically no loss of time.

Adjustments of the Boom

The position of the boom (i. e., the angle it makes with the horizontal), has an important bearing upon the service operation of the shovel. When the boom supports are adjusted to their full length, the boom "swings low" and the dipper is correspondingly affected by an increase in its "reach" and a decrease in its "clear lift." A shortening of the boom supports produces correspondingly opposite results.

Apart from the "reach" and "clear lift" conditions of the dipper mentioned above, the adjustment of the boom may be made use of for the purpose of balancing or poising the dead load of the shovel combined with the dipper live load when the latter is engaged in filling and swinging operations. In this connection, it must be borne in mind that the boom and operating machinery stresses are increased by a lengthening of the boom supports.

The delivery of the dipper is effected by a swing of the boom or by a rotation of the shovel body, according to the class of shovel used. To be most effective, the complete operation must be executed as a practically continuous movement. This is commonly accomplished by permitting the dipper to coast free of swinging engine action over a short distance at the end of the delivery swing, thus permitting the engine cylinders to become free of steam and in complete readiness for the reverse movement, which returns the dipper to the desired position for reloading. Coasting the dipper, as herein described, relieves the boom, swinging engine and other appliances from the shock and impact stresses which would result if the swinging engine remained in operation up to the instant the dipper delivery movement were completed.

Cars, wagons or other appliances used for the transportation of excavated material may be subjected to injury as a result of carelessly executed dipper delivery. This condition applies especially to rock excavation work.

In all dipper and boom operation, the operator should aim to eliminate excess movements involving losses of energy and time. In this connection a practical application of the theory of "motion study" will accomplish surprising results. The most common sources of loss are (a) failure to land the dipper in a position from which the thrust and raise movement can immediately be begun; (b) failure to stop the upward move-

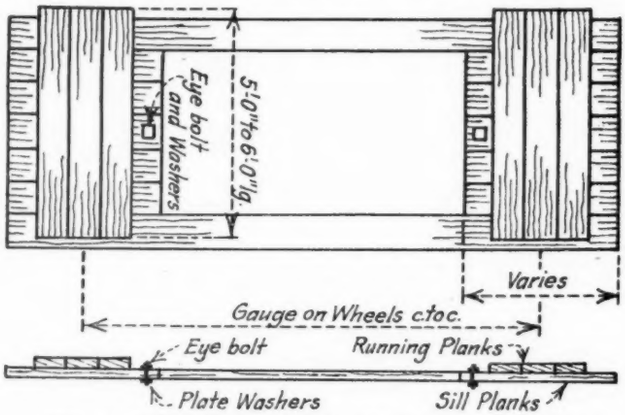


FIG. 3. BUILT-UP WOODEN TRACK—ALL PLANKS BOLTED OR SPIKED IN PLACE.

ment of the dipper immediately upon the completion of the filling operation; (c) failure to properly adjust the elevation and distance locations of the dipper during the operation of swinging, in readiness for the delivery to cars or other transporting vehicles; and (d) failure to release the dipper door immediately upon its arrival in position for the delivery of its load.

Care of Shovel Machinery

Successful shovel operation depends mainly upon the energy, skill and brains put into the work by the operator. The care which he bestows upon the engines and other operating parts is doubtless the most important factor.

Recognizing that a working shovel is the mainspring of the job, he will constantly be upon the lookout for loose nuts, broken bolts, and improperly adjusted gears, bearings, etc. He will "listen for knocks," well knowing that a loose bolt will produce a "knock," and that a "knock" unattended to is a sure forerunner of a "knock-out."

If, perchance, the "knock-out" materializes through ordinary and unavoidable wear and tear or otherwise, he will endeavor, by the exercise of trained intelligence, to accomplish such temporary repairs as will permit of continuing the operation of the shovel until such time as permanent repairs can be made without a complete tie-up of the work.

Reckless operation frequently takes the form of a sudden

application of full steam to an engine, the too abrupt application of a retarding or stopping force, or a too generous thrust of the dipper with the inevitable result that the operating parts of the shovel are subjected to excessive stresses and uncalled-for abuse. Naturally enough, the operating costs will be augmented as the result of breakdowns and repairs.

The writer desires to express his thanks for helpful suggestions received from W. L. Davis, whose long, practical experience in shovel operation has been of material assistance in the preparation of this article.

Acknowledgment

The foregoing article by Captain Edwards is here reprinted from a recent number of The Canadian Engineer because of its undoubted interest and value to American engineers and contractors.

Improving the Status of Municipal Engineers

To the Editor:

"I watch with very much interest the work done by the American Association of Engineers and give that organization due credit for bringing about a very marked improvement as regards the status of the engineer engaged upon railway work. The other evening I was talking with the superintendent of one of the trunk lines entering Savannah, and he expressed gratification at the work accomplished by the organization and approved their action in bringing about greater recognition of the importance of this branch of their service.

"At the time the local chapter was formed here I deferred joining the organization, being a member of so many societies that I felt my time, as much as could be spared, wholly taken up with other work. I notified the local secretary here then that I would be pleased to do anything I could to further the interests of the association and would be glad to join with it for the purpose of aiding engineers and others allied with this work.

"In connection with the work done for engineers, architects and others connected with railway work, I am very desirous to see a move taken by the engineering societies to further the project whereby there will be a Federal Public Works Department. Having been connected with the government for the long period of 21 years, I feel justified in expressing an opinion that public works could be better carried out by the organization of a department distinct and separate from the Engineer Corps of the army. The engineers engaged upon very important work are, as a rule, underpaid.

"Again, I am very much in favor of furthering interest in the city manager plan of government. Recently an association of city managers has been formed, and they are mapping out work which, I believe, will further the movement, which in my mind is fast becoming popular with many municipalities.

"Just so long as the people will stand for periodical decline in municipal management, so long will there be difficulty in obtaining capable and efficient engineers to accept uncertain and temporary employment with municipalities. I don't know that there is any section of the country that is worse than another as regards this matter. The public must be educated and must take more interest in city affairs to prevent the numerous occurrences where city management slips backward.

"Whether the real engineer, by organization, can assist in this important matter remains to be seen, but it should be the duty of the true engineer who becomes connected with a municipality to have it distinctly understood that he serves only with the understanding that politics will not enter in his work, and we have had a number of instances recently where good men resigned where it came to a point where the political machine came into control. By so doing, the time will come when the engineer will be more respected and will be viewed in a different light than he has been in the past.

"As stated before, it is my intention to become connected with the American Association of Engineers and to enter as a fighter for improvement, and I shall incorporate in my talk to the American Society for Municipal Improvements, at New Orleans, this fall, some ideas as to how the organization can take action and bring about improvements."

Very truly yours,

E. R. CONANT, Consulting Engineer,

April 15, 1919. 115 E. 31st St., Savannah, Ga.

Poor Brick Cause Pavement Failure—The Saving of $50 for Tests Leads to Failure of a $50,000 Job

By C. C. Wiley, Associate in Civil Engineering, University of Illinois, Urbana, Ill.

In 1913 the city of Champaign, Illinois, replaced a very rough, 30-year-old, two course brick pavement with one of a more modern type, consisting of 4-in. vitrified paving block on a 1½ in. sand cushion with a 6-in. concrete base.

VIEWS SHOWING COMPARATIVE RESULTS OF RATTLER TEST OF GOOD AND BAD PAVING BRICK AT CHAMPAIGN, ILLINOIS.

No. 1	No. 2	No. 3	No. 4
Ave. 13.1	Ave. 30.7	Ave. 47.7	Max. 13.2
Max. 16.0	Max. 41.1	Max. 100.0*	Max. 13.2
Min. 10.6	Min. 23.1	Min. 25..6	Min. 9.7

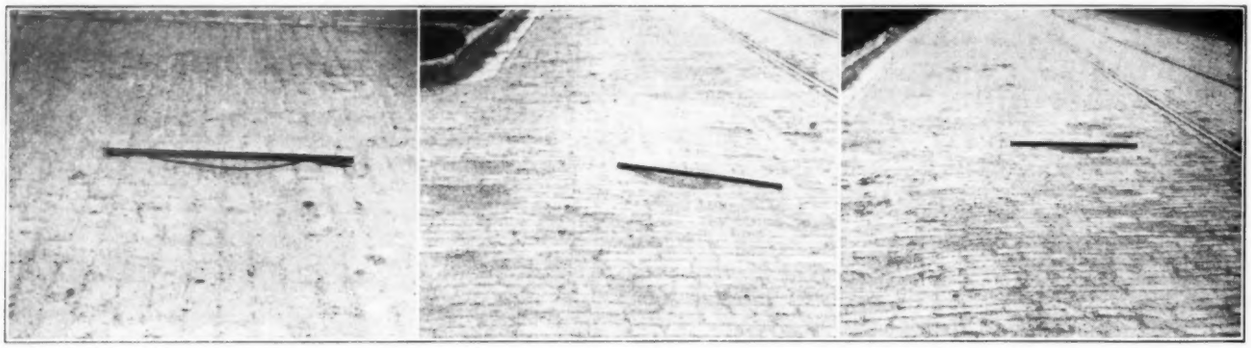
*The largest fragment weighed only 9.5 ounces, considerably less than the one pound fragment permitted by the specifications for the rattler test.

The brick used were of two kinds. About one-third of the project was laid with a brick much used in that locality and of known excellent quality. Due apparently to the inability to secure a sufficient number of these brick at the desired time the remainder of the job was laid with another brand of brick, which also had been used to some extent and was known to be rather erratic in quality. For some reason, however, no tests were made on these bricks although facilities for so doing were easily available at the University of Illinois, within less than a mile of the job, and a sum of $50 would probably have covered the expense of having a sufficient number of tests made.

No Tests Made Before Construction.

The street in question, East University Avenue, is the main thoroughfare leading from the business district of Champaign and the railroad stations toward the university and the city of Urbana. It consequently carries a large amount of fast motor traffic in addition to a considerable amount of moderately heavy teaming and trucking traffic.

Almost immediately after completion the portion laid with the second brand of brick began to show signs of wear. By 1918, the year the guarantee bond expired, this section had become very rough, numerous small pot holes had developed, and the whole surface was wearing very rapidly. In contrast to this the section laid with the first brand of brick exhibited a smooth, even surface and practically no wear on the brick.



VIEWS OF BRICK PAVEMENT ON UNIVERSITY AVE., CHAMPAIGN, ILL., SHOWING HOLES WORN IN SOFT PAVING BRICK AFTER 4½ YEARS OF SERVICE.

Tests Made After Failure.

Although it seemed evident that the fault lay in the brick, and was not due to foundation or cushion trouble, it was decided to make some investigations to establish the fact definitely. Accordingly a number of openings were made, the cushion and foundation examined, and samples of the brick secured for testing. In none of these openings was there any evidence of substructure trouble but in every instance where the second kind of brick were used they showed unusual wear, amounting in some cases to nearly half the depth of the brick.

Tests at Right Time Would Have Thrown Out Poor Brick

Samples of the brick were taken to the highway laboratory of the University of Illinois and submitted to the standard rattler test, each brick being marked for individual record. All samples of the first variety of brick showed average losses well under the 23% fixed by the specifications, in fact no individual brick reached this amount. Of the second brand of brick, however, only two samples showed an average loss of less than 23% and even in these a number of brick showed individual losses much greater. The other samples all showed average losses much in excess of that permissible and many single brick showed extremely excessive losses. Without doubt had proper tests been made at the time of laying the pavement these brick would have been rejected.

One of the accompanying photographs shows four of the samples after testing. The two end piles are average samples of the first brand of brick, the second pile is an average sample of the second brand, while the third pile shows the worst specimen of these brick. The other views show some of the holes that developed in about 4½ years, due purely to wear of the brick.

Based on these investigations an agreement for replacement was made, involving of course only the second brand of brick. Two car loads of new brick were received but this time tests were made to determine their quality and also by means of individual records to establish if possible some percentage basis for culling. The results of these tests, however, proved rather curious. There appeared to be no relation whatever between the rattler loss and the color, weight, shape or absorption. In short, there seemed to be no certain method of properly inspecting and culling the brick and consequently all were condemned. Meanwhile no replacement has been made, the pavement is rapidly growing worse, and the traveling public, as well as the property owners who paid for the pavement, are complaining.

Saving $50 at Cost of $50,000

This experience shows anew the folly of permitting the use of materials of unknown or questionable quality without careful investigation, tests, and inspection to insure their suitability, and also how the "saving" of perhaps no more than $50 to the "tax payer" may result in the ruin of a job costing $50,000 or more, as in this case, in which the people are investing their money.

The Sewage Disposal Problem in Chicago

By C. D. Hill, Engineer, Board of Local Improvements, Chicago, Ill.

Sewage disposal in Chicago is by the dilution process. The raw sewage of Chicago and its environs is discharged either directly into the main channel of the sanitary district of Chicago, or indirectly by means of the Chicago river, its branches, or other adjuncts of the drainage system. None of the sewage from the territory extending from the northern limits of Cook county to the state line of Indiana is discharged into Lake Michigan, with the exception of that from a portion of the city of Evanston, where intercepting sewers are now being constructed that will divert this sewage from the lake to the north shore channel, and with the exception of sewage contaminated water from the Calumet river. The Sag channel, which is nearing completion, and the Calumet Intercepting sewer system, which is now under construction, will eliminate this source of contamination. There still remains a very serious source of contamination from the sewage from the municipalities of northern Indiana bordering on the shores of the lake.

The intakes of the water supply of Chicago are so located that the water is usually quite pure, but because of possible

contamination the water is sterilized by chlorine so that one may drink the water without danger.

The completion of the present projects would seem to provide a complete solution of the sewage disposal problem, but, because of the growth of the city and because of the changing conditions, we will find that new projects and new methods will be needed before the present works are fairly completed. This has happened several times in the past.

Important Work Now in Progress

At the present time intercepting sewers are being built in the city of Evanston, which will divert its sewage from the lake to the North Shore channel.

In the Calumet district work has been in progress for some years on the construction of the Sag channel which will connect the Calumet river with the main channel of the sanitary district. This channel is necessarily small in capacity, while the storm flow of the Calumet river at times is very great. This makes it necessary to divert all sewage from the Calumet river, and intercepting sewers are now being built which will accomplish this purpose, the sewers discharging into the Sag channel just below the point of connection with the river.

Unsettled Controversy with Federal Government

The act of the legislature, which provided for the construction of the sanitary district channel, required 300,000 cu. ft. of water per minute to pass through the channel for the purposes of dilution at the time the channel was first opened, and required 600,000 cu. ft. per minute when the population of the district should increase to 3,000,000.

The channel as originally built through the rock section had sufficient capacity for this maximum flow, and through the earth section, while its original capacity was that of the minimum amount, it has since been widened so as to provide for the maximum flow. When the channel was first opened a permit was granted by the United States authorities for a flow of 250,000 cu. ft. per minute through the Chicago river. This was supposed to be the maximum amount that could flow through the river at that time without interfering seriously with navigation. Since that time the river has been deepened and straightened and in some places widened so that with a maximum flow there would be little, if any, interference with navigation. The Federal authorities, however, insist that the limits of the original permit still apply and that there is serious objection to permitting an increase because of the danger of lowering the level of the lake. The fact that the level of the lake today is considerably higher than it was in 1900, when the channel was first opened, does not appear to affect the argument.

The experience of the past 15 years indicates that the rate of dilution recommended by the commission was barely sufficient to provide for the sewage from the population of the district. This rate, however, did not take into consideration the gross pollution from industries, and the actual condition of the water in the channel for the past few years has not been satisfactory, principally because of the vast amount of filth discharged into the channel from industries and particularly from the stock yards district. The pollution of the water that is discharged into the Desplaines river and Illinois river is sufficiently great to justify complaints from residents of the state living along the borders of the rivers; this is despite of the fact that at times a larger flow is maintained than was contemplated under the terms of the original permit from the Federal authorities. There is serious danger that the Federal Government will not permit the increased flow that is needed and may indeed restrict the flow to an amount that would be entirely inadequate.

These conditions have led to numerous negotiations with Federal authorities and to the instigation and prosecution of litigation, but no results have been obtained either from the negotiations or from the litigation. At the same time the sanitary district of Chicago has made continuous studies of the problem, particularly with respect to various methods of sewage purification that might be installed in case the Federal Government should not permit the necessary dilution. These studies were appropriate even though the Federal Government should permit the maximum flow through the channel, for the reason that the time is approaching when the population of the city will exceed that which was contemplated by the commission which recommended the present works.

The sanitary district has made a series of investigations as to the treatment of industrial waste and particularly the waste from the stock yards district. Definite conclusions have been reached as to the method of treating the waste from the stock yards district, and negotiatons are pending as to allotment of the cost of establishing and operating such purification works.

Present Situation is Critical

The situation today is quite critical. The Federal Government may restrict the flow from the lake so that it will be impossible to dilute the sewage to the extent required by the Act of 1889. Under this condition the state would be justified in objecting to the discharge of the grossly polluted water from the canal into the Desplaines river, and requiring the construction of supplementary works for treatment of the sewage. To build new treatment works, that would purify the sewage sufficiently so that with the limited dilution of lake water the effluent would not constitute a nuisance, would require years and would cost so much that it would be necessary to obtain legislation to sanction their construction.

People Unconcerned

There is a lack of appreciation on the part of the general public in Chicago of the seriousness of this situation. Few people realize the opposition of Federal officials to the operation of the channel in accordance with the original plan, and fewer realize the opposition to Chicago from the people of other cities along the Great Lakes. This opposition is due largely to a mistaken notion as to the effect of the flow of water through the channel upon the level of the lakes; nevertheless, it is real.

Treatment Works Must Be Built

If we should be so fortunate as to obtain from the Federal Government permission to operate the channel at its full capacity, it will be difficult to make the people of this community understand that, because of the growth of population and the consequent increase of pollution of water, it will be neecssary to install auxiliary purification works, and once more we will repeat history by showing by actual conditions the inadequacy of present methods long before new works can be installed.

One thing should be made plain, and that is that there has been made no serious mistake in the successive steps through which the sewage disposal works of Chicago have evolved, except the mistake of procrastination. Each step has been logical and reasonable, and to have attempted other methods would probably have been unwise.

Procrastination Only Mistake So Far

At the time the present works were planned there was strong argument on the part of a few progressive engineers that the construction of a large canal providing for dilution was unwise and extravagant, and that a much better plan would be to build sewage purification works. If such a plan had been followed, the method of purification adopted would probably have been obsolete before the work had been fairly started, and if Chicago could have changed its work as often as the engineering profession has changed its opinion as to the most effective method of sewage purification, the works would have undergone a continuous process of rebuilding.

The foregoing matter is from an address to the Sanitary Engineering Section of the American Public Health Association at the recent annual convention in Chicago.

Methods of Removing Crenothrix from Public Water Supplies—Chlorine Treatment is Successful

By W. F. Monfort, Consulting Chemist, 506 N. Vandeventer Ave., St. Louis, Mo.

In reviewing the methods of ridding infected iron-bearing water supplies from crenothrix it becomes apparent that 50 years of investigation have not fully explained the relation of the organism to the divers troubles associated with it.

Life Processes of Crenothrix

In the most recent classification crenothrix is thus described. "Filaments, unbranched, showing differentiation of base and tip, attached, usually thicker toward the tip. Sheaths plainly visible, usually colorless, brownish from iron oxide in old filaments. Cells cylindric to spherical. Multiplication by non-motile, spherical conidia; cells dividing in 3 planes to form conidia." (J. Bact. 3,305). Wolle (Fresh Water Algae of North America, 1887) said: "The peculiar colorlessness and gelatinous consistency of the plants suggest a relationship with some of the forms of filamentous fungi. Cohn and Zopf retain it as an algae."

Since the sheaths of its older filaments occur in iron ore deposits it has been thought to bear a casual relation to the formation of beds of soft iron ore, as in the Mesaba range. (U. S. G. S. Monograph 47, 826.)

The life processes of the organism are difficult to establish. Whether the segregation of ferric hydroxide in older but not vegetative threads is a source of energy (Winogradsky 1913), or a mechanical phenomenon not connected with the life processes of the cell (Molisch and Ellis) remains in dispute. Rossler reports the growth of crenothrix on porous porcelain in a ferrous sulfate solution.

Thresh, however, reports it as growing on potato moistened with a very dilute solution of ferric chloride. It is usually stated that no medium permits the growth of crenothrix in the laboratory. A possible explanation of these discrepant statements is suggested later.

Another suggested source of life-energy to the organism is in the carbon dioxide liberated from ferrous carbonate in iron bearing waters.

More definite knowledge is needed. As pointed out recently by Harder (1915) the isolation of the higher iron bacteria from the simpler ones, cocci and single-celled bacteria, and their study in pure culture are attended with great difficulty.

Nature of Trouble Caused

That in many instances bacteria of putrefaction accompany it and the life reactions of these and other bacteria may share in the changes usually attributed to crenothrix is evidenced by the obvious decay of its accumulated masses.

Since the water calamity in Berlin in 1878 there has been no doubt that crenothrix is associated with acute troubles in water supply systems, in that the organism, by its growth and decay in reservoirs and mains, gives rise to foul odors and tastes, the separation and collection of ferric hydroxide and the discharge at irregular intervals of foul, red water.

When crenothrix collects in filters the blackened decaying masses in the sand are the nidus for putrefactive bacteria. Because of the threadlike nature of the growth, the sand penetrated is held together so that effective washing is difficult. Once a bed has been penetrated progress through underlying gravel and underdrains is rapid; the conidia are capable of beginning new growth wherever conditions are favorable. In one clear water reservoir decaying crenothrix formed a bottom sludge wherein chirnonmus larvae found comfortable lodgment.

As will appear below, the iron demand of the organism is not fixed for all waters; its variations may be occasioned by the reactions of other bacteria in making available the necessary food stuffs. A prolific growth has occurred in one water carrying but 0.3 parts of iron.

The degree of reduction in iron content possible with aeration and filtration through sand varies with the amount and kind of organic matter present. The residual iron in a filter effluent freed from crenothrix is not necessarily such that crenothrix cannot thrive therein; it is rather true that crenothrix does not pass the filters. Yet in one case cited below, in mains already inoculated, fresh growth did not occur although the water contained 0.9 and 1.10 parts or iron per million.

The suggestion is pertinent that the organic food stuff at hand may not have been directly available to crenothrix until transformed by other bacteria. It is possible also that the failure of workers to repeat the culture of crenothrix in the laboratory reported by others is accounted for by symbiotic action in the successful cases and its absence in the unsuccessful.

Rationelle of Treatment

The treatment of iron-bearing waters in which crenothrix occurs has been greatly affected by the notion of the relation of the two factors—iron and the life processes of the organism.

It is stated in Whipple's resume (Microscopy of Drinking Water p. 249) that crenothrix thrives in water containing iron, rich in carbon dioxide, low in dissolved oxygen and high in organic matter. The last factor is to be associated with albuminoid, ammonia, organic nitrogen, color and oxygen requirement. Whether free ammonia is a food stuff or a life product of crenothrix and attendant bacteria in such waters is undecided.

Elimination of crenothrix according to this conception would involve one or more of these four factors: iron removal, addition of oxygen, CO_2 removal, removal of organic matter and possibly ammonia.

Lime Treatment

At Freeport, Illinois, in the fall of 1895 the water supply derived from wells in drift along the river bottom suddenly acquired a bad taste and odor, which could not be accounted for in the ordinary way. Crenothrix was found in the mains. It was believed to require about 0.3 p.p.m. iron for its growth and methods were experimented with to reduce the iron content. An experimental filter was put in operation, using lime. It developed that a reduction of the iron content from an average of 0.796 to 0.045 p.p.m. could be effected and the carbon dioxide from 21.4 to 0 p.p.m. by the action of lime.

A filter plant was constructed in 1903 and put in service October 13; the iron content was reduced in the test run to 0.04 p.p.m.; the CO_2 was entirely removed and the water softened 13 to 15 per cent. During the six months following the completion of the plant, these results were continuously maintained, and the old growth removed from the lines by flushing. (Proc. Am. W. W. Assoc., 1904.)

It is impossible to say what changes were made in the amount of organic matter in this process; whether it was much or little affected by this treatment; but it is probable that it was largely eliminated along with CO_2 and Fe by the use of lime.

The removal of carbon dioxide can be accomplished by aeration, which also aids in precipitating a considerable proportion of the iron content. Aeration followed by filtration was the procedure rationally growing out of the early knowledge of crenothrix. That this process also reduced the organic content of such waters is probable; but the extent of the reduction would vary with the amount of organic coloring matter.

Aeration and Filtration

Early treatment in Berlin (1887) and in Rotterdam (1887) was by aeration and filtration.

A later application of this method to crenothrix and iron removal at Superior, Wis., developed the fact (Proc. Am. W. W. Assoc. 1909, 250) that with aeration, crenothrix was eliminated by slow sand filters, and did not reappear in effluents containing .90 to 1.10 parts iron per million gallons with a color of 25 to 35. Without aeration, filtration through sand eliminated crenothrix; reduced the iron content to about 0.8 parts and the

color to 23 parts; but there followed such a pronounced clogging by the increased precipitate of sticky ferric hydroxide that the capacity of the filters was insufficient to handle the quantity of water required.

In this case the two-fold character of the problem is plain: crenothrix removal by sand filters was simple; iron removal or reduction was considered as a separate matter to be independently treated. Carbon dioxide reduction was finally neglected; crenothrix was filtered out, with the readily precipitated iron, and the effluent diluted to permissible color with iron free water from other sources.

Here again it is presumable that bacterial changes occurring within the Schmutzdecke and the sand brought about a change in the organic matter, unfavorable to the later growth of crenothrix in the previously infected mains.

Iron Removal by Crenothrix Growing in Filters

From experimental work by Professor A. N. Talbott at Urbana in 1910-12 the conclusion was reached that good results could be obtained in a water containing no dissolved oxygen; 40 ppm CO_2; 2 ppm Fe; and 2 ppm NH_4, by partial aeration; reducing but not altogether eliminating CO_2 and introducing 4 to 5 ppm. dissolved oxygen (50 per cent. of saturation), followed by filtration through coarse (torpedo) sand passing 8-mesh and stopped on 12-mesh. This sand (effective size .76 mm. and uniformity coefficient of 3) upon which and into which crenothrix grew, removed all but 0.3 ppm iron for some months. Washing with an upward velocity of 1 foot in 50 seconds dislodged most of the visible filaments of the organism; passing the coarse sand through a centrifugal pump at six month intervals was recommended to insure continuously good results. (Proc. Ill. State Water Supply Assoc. 1911-12-13.)

In this instance use seems to have been made of the organism itself with its allies as an iron removing agency, assisting by infiltration of the older sheaths with ferric hydroxide, the action of the sand grains and their accumulated slime coating in absorbing and retaining the dissolved and precipitated iron.

Although these good results were attained for a period, the penetration of crenothrix into and through the sand, fine gravel, strainers, and underdrains was eventually complete, probably because of less perfect washing than was contemplated by the designer of the plant.

While the reduction of iron to 0.3 ppm or less continued, crenothrix grew abundantly in the clear water basin, in mains, and in service pipes, indicating that oxidation to 50 per cent. saturation did not deter growth of crenothrix or the attendant bacteria of putrefaction. Furthermore it is true that the iron demand of crenothrix is much lower than was formerly assumed. Possibly iron is not essential to crenothrix growth as Ellis and Molisch have claimed.

Germicides Copper Sulphate

Passing from these attacks on the crenothrix problem by removal of what were thought to be its essential food stuffs, we now consider the direct attack on the organism with germicides.

Since 1904 copper sulphate has been frequently used as an algicide. In his latest publication on the subject, Kellerman (8th Int. Cong. Applied Chem. vol. 26 p. 241) confirming his previous experience gives the amount of copper sulphate necessary to destroy crenothrix as 0.3 ppm.

This algicide was applied to the Champaign-Urbana water by Mr. Edman Greenfield some time since. He reported that the high bicarbonate of this water prevented solution of the copper salt and materially lessened its germicidal effect. The experiment was carried no further.

Chloramine Experiments

Considering crenothrix as one of the bacteria subject to the action of germicides, some experiments were undertaken late in 1917, using chloramine, which are described in a paper to appear in the next number of the Journal of the American Water Works Association.

It is sufficient to state here that in laboratory tests it was shown that 0.5 parts per million or 4.17 lbs. of available chlorine per million gallons prevented growth in iron-bearing crenothrix laden water from the university well at Urbana. Samples so treated developed neither taste nor odor during six months' storage although control samples untreated and treated with 1 part per million of available chlorine in bleaching powder gave an abundant growth and thereafter the characteristic taste and odor attributable to this organism.

Without preliminary aeration or iron removal, crenothrix was killed by chloramine and its detritus suffered no decay. The destruction worked by chloramine included, therefore, both the conidia and growing cells of crenothrix and the attendant bacteria responsible, by their activity upon dead detritus, for the putrefactive changes productive of odors and taste in the afflicted waters.

This is of interest as showing the relief offered by such treatment from immediate and remote troubles caused by crenothrix. The attack through the agency of germicides gave promise of simplifying the dual problem of crenothrix-iron removal, safely eliminating crenothrix without embarrassing iron removal, all the while insuring against foul odor and taste. Discussion of the germicidal action of chloramine will be found in the published paper.

It was proposed to apply it at the Champaign-Urbana iron removal plant, but the war demand for both bleach and ammonia was pressing and deliveries were uncertain.

Chlorine Treatment

In February, 1918, the writer recommended to Mr. Amsbary, manager of the Champaign-Urbana Water Company, whose problem was then acute, that 4.5 lbs. chlorine per million gallons be applied to the well water passing to the filters, using a small emergency solution feed apparatus loaned him for the purpose. From Mr. Amsbary's statement (J. Am. W. W. Assoc. for June 1919) the following is quoted, "The crenothrix growth had possession of the filter beds, rendering them inefficient; the reservoirs were foul with it, requiring frequent cleaning. The distribution system was supporting its proportion. Since pipes were stopping up all around the city, the situation was serious indeed. The use of chlorine, introduced into the raw water as it enters the filter beds, had an immediate effect on the crenothrix, causing it to disappear, and since its use began, we have been free of the pest. The filter beds are easily kept sweet and clean; efficiency 90 per cent. and no growth can be detected in the basins or distribution system. It has been a great relief, as complaints which were numerous before its use, have entirely ceased since chlorine has been used."

Mr. Amsbary's reference in the phrase "efficiency 90 per cent" is to the per cent of iron removal from 2 parts per million in the raw water to about 0.1 ppm. in the filtered effluent, which is rather better than the average of earlier results here.

The filter beds which are supplied with fine sand show a reddish film when drawn down, but filaments of the organism formerly so persistent are not found. This seems to indicate that chlorine treatment is efficient in preventing growth of this and its attendant bacteria. Upon scraping away the top ¾ inch of fine sand, there was found fresh, uncolored, unmatted sand, indicating that the iron removel was occurring at the surface only.

Before chlorine treatment was begun, all filters were washed twice daily, and the wash water returned to the receiving chamber after coagulation with two grains alumina sulphate per gallon and sedimentation in a 90,000 gal. reservoir from which all but 0.8 per cent. was recovered through a floating suction. The organic matter in this recovered wash water had putrefied in the receiving chamber and had furnished a nidus for tubificid worms and other foul bottom organisms; this situation made all the more difficult the problem of furnishing a satisfying supply. The accumulation from the receiving chamber was removed shortly before chlorination was begun. (J. Am. W. W. Assoc. 2, (1915) 393.) Bacillus coli was always present.

The filter beds are now washed once in 24 hours; the wash water is still coagulated, settled and recovered through a floating suction; but the worst effects of this questionable practice have disappeared. Bacillus coli is absent.

One of the four filter beds is supplied with fine sand supported on adequate gravel; one has good sand directly on the strainers, through some one's inadvertence; the other two have their original equipment of 30 ins. of torpedo sand on 8 ins. of ¼ to ½ in. gravel.

That the germicide applied to such filters and under these conditions has sufficed to free them from old growth and infection and keep them sweet is gratifying. It is hoped that easier labor conditions may soon permit the manager to complete the equipment of the filters with sand and gravel in accordance with the recommendations made in 1917.

That the defective filters with chlorine have given an unimpared iron removal for more than a year augurs well for the safe working with an even smaller chlorine charge of the better ones, which will have but this one function to perform, namely, iron removal.

Summary

Filtration of water supplies infected with crenothrix is accomplished by removal of the organic matter which is probably the essential food-stuff of the organism. Iron removal is probably incidental; carbon dioxide removal may be either partial or total; both are believed to be non-essential to the life and growth of crenothrix. The destruction of crenothrix and accompanying putrefactive bacteria by the germicidal action of chloramine or chlorine before filtration facilitates subsequent iron removal, and insures the supply thus treated against subsequent development and putrefaction of crenothrix.

A practical test through a period of more than a year has shown 4.5 lbs. chlorine per 1,000,000 gals. of applied water effective in clearing a seriously infected system of filters, reservoirs, mains and service pipes of all accumulations, rendering the water free from taste and odor and color. The iron content is reduced to 0.1 part per 1,000,000.

Acknowledgment

The foregoing paper was presented at the recent annual convention of the Indiana Sanitary and Water Supply Association.

Why Materials of Construction Should Be Tested Prior to Their Use

By Emmanuel Mavant, Concrete Expert with Milton Hersey Co., Ltd., Consulting, Inspecting and Testing Engineers and Chemists, Montreal and Winnipeg, Canada.

One often wonders why it is that so many engineers and architects seem averse to having their building and structural materials inspected and tested before accepting them for use in their work. Too often this is omitted during the construction of high priced dams, bridges, breakwaters, buildings, etc., where the professional reputation of the engineer or architect, the capital of the investor, and, quite frequently, the lives of many people are at stake.

Is it through ignorance? Is it through jealousy and selfishness; not wanting any other engineer or chemist to share the credit for the appearance or assured safety or the structure? Or is it through a mistaken economic point of view? We will review these points one by one.

Some consider testing unnecessary

Is it through ignorance? I may answer that in quite a few cases it is. Engineers of high standing have deliberately claimed to me that it was not necessary to test anything; using as an argument that cement was standard, that any experienced man could tell good sand at sight, and that, as far as stone was concerned, limestone was limestone and that was all there was to it.

These men start the work without knowing the quality of the materials they are using; and, too frequently, their structures fail. If it is concrete, the mass crumbles, disintegrates, cracks, or otherwise goes to pieces, and the average person who sees it concludes that, after all, concrete is a poor investment.

Why Cement Should be Tested

Let us review the arguments of these engineers. They claim that cement is standard. I say it is not; though I know the cement manufacturers, especially the larger ones, do all in their power to have the cement not only up to specifications, but as nearly perfect as possible. But the chemist and superintendent can not be all over the works at once; and, for that reason, there is always a possibility, though it may be remote, of the cement coming out too fresh, too high in sulphuric anhydride, or in magnesia, or too low in specific gravity.

Quick Setting Cement

These defects, which can not be found without having the cement tested, will cause many different troubles in concrete work. For instance, one defect will cause the cement to set too quickly; that is, it will take its initial and sometimes its full set before being placed on the job, while the men are mixing it. In this case there will be no cementitious qualities between the different lumps of concrete as it breaks up when being deposited, and so many stones covered with mud might just as well be thrown into the forms; the results would be as good.

Slow Setting Cement

On the other hand, another defect might cause the concrete to set too slowly. This naturally retards the work, because the forms can not be taken off as quickly as planned. If the risk is taken and the forms removed, there is a great possibility of the structure failing. If slow setting cement is used in the winter time and freezes before it sets, the concrete will soon disintegrate. Even if it should not totally collapse, it will be a constant cause of expense for repairs and an ever-present eye-sore.

I had occasion, some time ago, to condemn 18 cars of cement containing over 16,000 bags and amounting to over $11,000 in value. These 18 cars, which had been purchased by two of our largest Canadian manufacturing firms, were condemned for the reason that the setting took place in from 8 to 20 minutes. It should take at least one hour as determined by the Gilmore needle. Had not that cement been tested, it would naturally have been used, and, without a doubt the work would have failed because of the concrete setting before being placed.

Deterioration During Storage

Outside of this particular case, I have had occasion to condemn cement quite a few times in different parts of the country. In the majority of cases, the cement manufacturer was not to blame for these failures in cement, but either the railway company or the contractor was responsible. Cement is often stored in unsuitable sheds where dampness and rain injure it. Many of us have seen bags that were set as hard as rock taken out of temporary storage sheds. In such an instance, while only certain bags may be unusable, many others, and frequently a very large quantity, have been affected to such an extent that they should not be used.

Another instance came to my attention last summer. An electric power development company situated in the Province of Quebec, were about to raise their dam. The cement was purchased and stored beside the falls in an enclosure with no front. After this was filled with cement, a few boards were put up to protect the cement from the spray of the falls, but cracks ranging from 1 to 10 ins. were in evidence. The result was that the spray reached many of these bags of cement, making some of them so hard they had to be broken up with shovels before using. I drew the attention of the superintendent to this fact, but his answer was that the cement was first class.

It stands to reason that had this cement been tested before using it would certainly have been condemned, as chemical action had already taken place, rendering it of little value. This is but one of the many cases where the cement company was not to blame, and similar instances occur almost daily; but, whether the manufacturer or the contractor is responsible if the cement is not tested, and the work supervised by an experienced concrete inspector, the investor is likely to suffer.

Why Sand is Tested

Now let us go into the sand question. It is claimed that any engineer or experienced man can tell good sand at a glance. That is impossible. He may be able to tell that it is too fine, if it is very much too fine, or too dirty, if it is very much too dirty; but, beyond that, engineers or experienced men can not tell at sight whether this sand or that is good and reliable for strong and dense concrete work.

Sand Lacks Uniformity

All sand contains more or less silt or dirt. The reason for this is that it is composed of small particles of broken rock, of different sizes and compositions, coming from different parts. These particles have been washed away or transported from their different sites at different times and settled in layers of different thicknesses in what is now a workable sand bank or deposit. Therefore, there is no guarantee or even likelihood of uniformity, and one carload of sand may be first class and the next of very poor grade for concrete work.

Also, the dirt and silt, which is very often injurious to sand for concrete purposes, are bound to be present in some parts of the sand bank; because the small particles of rock that are washed towards the bank will naturally carry with them more or less of this fine material.

The above shows conclusively that, in order to be sure of good results, the sand should be tested; not only once, but continually while the work is in progress.

Gradation of Sizes

Besides the avoidance of injurous silt, there is the size or grading of the sand to be considered. It should be well graded, having a certain proportion retained on each sieve from say the eighty mesh to the one-quarter in. sieve. If all the sand grains are of nearly the same size, the voids will be too great, and, unless an additional amount of cement is used, the voids will not be filled. If too fine, the concrete will not be of the required strength. The reason for having sand well-graded is so that the fine particles will fill the voids of the coarser particles, thus reducing them to a minimum.

In order properly to proportion a concrete mixture, it is necessary to determine the voids; for, without this information, the engineers are working blindly and probably wastefully. Where they are figuring on having a good dense concrete for a reservoir, oil tank or foundation, the result is likely to be different and if the water goes through the wall concrete once more gets a black eye.

Injurious Chemicals in Sand

Another very bad fault in some sands, which can not be determined without testing, is that they contain injurious chemicals. Sometimes the drainage from some industrial plant such as a chemical works, soap factory or tannery, though located several miles away, will contaminate a sand supply, rendering it unfit for use in making concrete. As a rule, such contamination is discovered by making 3 to 1 briquettes with the sand under consideration and also with standard sand. A comparison of the results will soon tell whether or not there are injurious chemicals present.

Some years ago, I had occasion to deal with a very interesting case of the above type. A company decided to build a concrete laundry building in Eastern Ontario on the site where an old stable had been standing for years. They tore down the old building; and, in excavating for the cellar of the new, ran across such nice looking sand that they decided to use it in the concrete mixture for the new structure. They had no end of trouble. The concrete would not set, and the walls fell in.

In carrying out an investigation, it was found that briquettes made of this sand would crumble in the hand after seven days setting. These briquettes were so disintegrated that they could not even be put in the machine to test. An analysis was made, and we found that the sand was saturated with ammonia which had percolated through from the horse manure.

As a result of this investigation, the sand had to be taken away from the site of the work, the old concrete thrown out, forms rebuilt, new sand purchased, and the work reconstructed. All this delayed the work, cost money for material and labor to replace that wasted, and inconvenienced the owners. A sensible program of testing would have prevented any of this trouble.

Poor Sand Responsible for Most Concrete Failures

I would venture to say that three-quarters of the failures in concrete are due to poor sand; and then some engineers will not hesitate to state that it is unnecessary to have sand tested.

As far as stone is concerned, the same argument holds as in the case of sand. In order to regulate the mixing of concrete, the voids must be determined; and, in order to get good results, the stone must be clean, strong, well shaped, and well graded.

It might well be stated that the best argument for the general inspection and testing of all building and structural materials is that every large corporation such as the Canadian Pacific, the Grand Trunk, the Canadian National Railways, the Montreal Tramways, the Montreal Light, Heat and Power Company, the Harbor Commissioners of Montreal, Toronto, Hamilton, London, Peterborough, the departments of the government, provinces, states, the counties and municipalities that are at all progressive, and large private concerns too numerous to mention, all have their materials thoroughly tested before using. The sooner other engineers and architects make up their minds to have testing and construction supervised by experienced men, the sooner eyesores, failures and constant repairs to concrete work will stop.

Some Engineers Do Not Like to Share Credit

I happened to interview the City Engineer of one of the larger cities of Canada on the subject of supervising concrete construction and the testing of the materials for it. After a long conversation, he agreed that the construction materials should be tested, but turned and said: "Where do we come in? You will be the party doing the work, and getting the credit. The Municipal Council will say, 'These engineers of ours are of no use if they must get their materials tested and work supervised.' If we were to do that, we might find ourselves out of a job."

Whether it is the effect of the above policy or not it is hard to say, but this particular city has had constant trouble and very heavy expenditures for replacing defective work. They erected a Fat Stock Show building, and the whole thing collapsed. Their water main cracked, and, as it was a suction system, sewage polluted water was sucked into the mains and contaminated the drinking water. This caused a typhoid fever epidemic that carried off in the neighborhood of a thousand people, and forced the city to open emergency hospitals that it had to furnish and provide with doctors, nurses and orderlies. The boiler in one of their municipal buildings exploded, killing one man, injuring others, and wrecked the building. A pavement about 25 city blocks in length took on the form of a corrugated road, and had to be relaid a few years after it was first put down.

It goes without saying that all this trouble cost the city many thousands of dollars which might, and very likely would have been avoided had all the materials used in these constructions been tested and the work supervised by some one particularly familiar with each type of construction. Any possible loss of prestige to any engineer or architect through

the employment of outside specialized inspection and testing service could not conceivably injure him as much as one failure such as we have mentioned. In fact, after the failure, some one will ask why he did not have knowledge enough to understand that he needed such specialized service. The family physician does not try to operate on his patient's heart; the City Engineer should not think it necessary to pretend that he knows it all either, and the same applies to the outside engineer or architect. Specialists usually pretend to know but one thing, but to know that one thing uncommonly well.

Mistaken Idea of Economy

A good many engineers will say that this or that work is not of sufficient importance, or will not be seen, so spending money on tests for it is waste of money. This is very unwise economy, in fact, not economy at all. It is a case of saving the pennies to throw away the dollars; for, when the construction materials are tested and accepted by specialists, and the work supervised by them, the engineer or architect is practically relieved of all responsibility except that of having selected competent specialists to do the work. He can not do all this himself. He must hire some one; so why not those particularly competent to take care of the particular matter for him?

Besides, if his plans and specifications are correct, he is sure there will be no unwarranted expense for repairs, and the structure will be there to stay as a monument to his name and a foundation for his future reputation in the engineering profession.

The engineers and architects who are foremost in their profession would not consider for a moment using materials of construction without full inspection and testing as the work progressed; therefore, why should men who have not yet reached the pinnacle of professional success risk failures that might forever preclude their arrival?

New Type of Portable Conveyor for Handling Loose Bulk Materials

A new type of portable conveyor, which cuts the labor of feeding one-half, is shown in the accompanying illustrations. The most distinctive feature of this machine, called the scoop conveyor, is the scoop on the feeding end which can be pushed into or completely buried in the material to be conveyed. This makes it possible to simply scrape the material onto the carrying belt instead of lifting it up by shovelfuls into the feeding hoppers as with ordinary conveyors.

Another special feature of this machine is the construction of the sides, or skirt plates, as they are called. These form a trough which enables a 12-in. belt to equal in carrying capacity a 20-in. ordinary troughed belt. This is readily understood when one remembers that on a troughed belt the material is carried in the center of trough, that on the sides falling into the trough or rolling back, whereas, the side plates on the scoop conveyor hold the material together, giving the whole width of the belt carrying effectiveness. It is due to the skirt plates, also, that a scoop conveyor 24 ft. long will convey material as high as a 30-ft. troughed belt. The resultant saving in belt expense is considerable, as two new 12-in. by 24-ft. scoop conveyor belts can be purchased for the price of one 20-in. by 30-ft. troughed conveyor belt.

While the scoop conveyor has been on the market only a short time, the manufacturers claim that there are now over 1,000 in use and that they are receiving nearly 50 percent repeat orders.

The money savings resulting from the use of a scoop conveyor are due, first, to the saving in labor; second, to the speed at which material is conveyed. In comparison with handling material by hand, one or two men with a scoop conveyor will do the same work as from four to twelve men, depending upon conditions. The scoop conveyor will load trucks in one-fourth to one-sixth the time required by men shoveling. It often enables one truck to do the work of two and of getting two days' work done in one day.

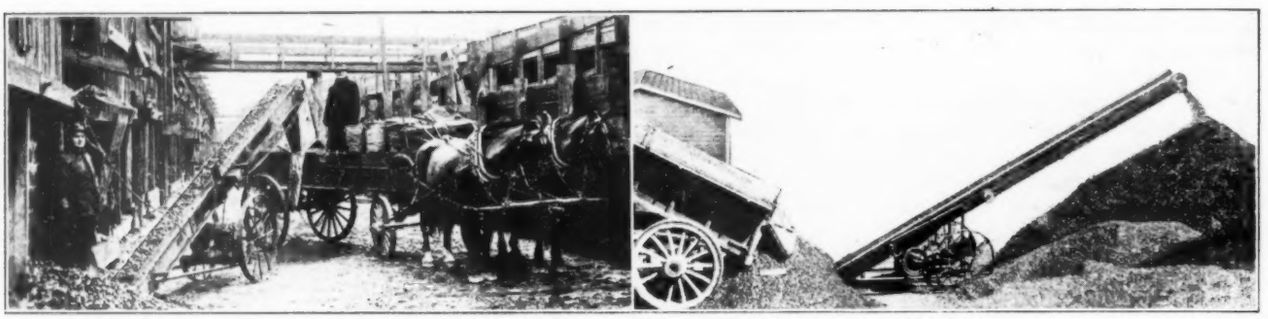
Storage capacity is another factor of saving attributed to this machine, as it increases the available capacity of a shed or yard space by enabling the men to pile higher.

The carrying capacity of the scoop conveyor, based on handling coal, is 1 ton per minute, provided a sufficient amount of coal is maintained at the receiving end of the machine. If the storage pile is of sufficient height, one man can easily feed 1 ton in 1½ minutes, or, if the pile is low, he may require from 2 to 4 minutes. Where speed is required two men may be provided for feeding. In unloading hopper bottom cars the machine and one man can remove 1 ton per minute.

Large size coal, coke, crushed stone, etc., fed by one man, require from 3 to 6 minutes for 1 ton or half that time with two men.

The scoop conveyor is used principally for storing, reclaiming and loading bulk material and light articles. There are a number of uses for the machine, in addition, such as elevating material to tanks or platforms in chemical and industrial works, feeding from cars and delivering into fixed conveyors or stoker magazines at power plants, etc. Almost any kind of material can be handled, such as coal of all kinds, ashes, sand, earth, crushed stone, blast furnace slag, ore, fertilizer, salt, chemicals, grain, bags and light packages.

The scoop conveyor may be used singly, in tandem or in triplicate, as may be required. The employment of sets of two or more allows for an increase in height of the storage pile or conveying distance. The machine is made in three sizes, 14 ft., 20 ft. and 24 ft. On either size the conveying belt may be 12 or 16 ins. wide. The machines are furnished with either electric motor or gasoline engine drive. This conveyor is manufactured by the Portable Machinery Co., of Passaic, N. J., who have just published a folder entitled, "Over 1,000 Scoop Conveyors," which illustrates all the uses of this piece of equipment.



VIEWS ILLUSTRATING USES OF THE PORTABLE SCOOP CONVEYOR.

Land Drainage Procedure in Iowa

By G. D. Hart, C. E., Consulting Engineer, Bancroft, Iowa

Throughout the states of Illinois, Iowa, the Dakotas, Minnesota and Wisconsin, as well as several of the southern states, countless miles of underground drains have been constructed. It is estimated that the state of Iowa will have used enough drain tile within the next ten years to traverse the circumference of the earth five times.

The size of drainage tile range all the way from 4 ins. in diameter to 6 ft. in diameter, although systems laid in the early history of drainage contained tile as small as 1 in. in diameter. Some of these are reported to be still doing service—after the manner of their kind.

The history of underground drainage probably began back in the years preceding 1620, when drain tile were discovered in the convent garden at Mubeuge, in northern France. Later the invention of "land pipes" was recorded in England, from whence they were finally brought to the United States. One John Johnston, of Geneva, N. Y., is credited with the honor of being the "Father of Tile Drainage in America." Between the years of 1835 and 1851 he placed some 16 miles of tile on his farm with gratifying results. From thence the drainage movement pressed westward, gaining in favor and magnitude as it progressed.

The magnitude of the tile-drainage industry may be perceived from the fact that in the state of Iowa alone there are 7,100,000 acres of land that require drainage to make it productive. The estimated cost of draining this acreage is $400,000,000.

From the viewpoint of strict engineering, drainage engineering is not overly spectacular. In fact, we find little or no mention of that branch of engineering in the press.

However, the design of an efficient drainage system is far from a scientific guess. To give ample service a drainage system must have sufficient capacity to carry the rainfall away with such rapidity that water will not stand over the roots of vegetation for a greater period than 24 consecutive hours.

The amount of water to be carried by the tile is affected by the following factors, viz.: amount of rainfall, frequency of rainfall, area of watershed; character of the land, flat or rolling; porosity of the soil, etc. In the area covered by this article it is customary to make the capacity of the tile sufficient to carry from ¼ in. to ½ in. run-off in 24 hours.

The velocity of flow in a system of drain tile may be calculated by any of the formulas for flow of water in channels or pipes, such as the formulas of Prony, DuBaut, Weisbach, Bazin, Chezy, Poncelet, Kutter and others. Certain modifications must be made, however, due to the following facts: A tile system is composed of short sections from 1 to 3 ft. in length, whereas pipes of iron or wood are usually continuous; drain pipes are usually rougher than iron or wood pipes; water enters a drain system at nearly every joint; laterals of greater gradient than the main exert additional head thereon, and the water in the soil above the tile adds a certain amount of pressure or head.

The formula in general use among drainage engineers is known as C. G. Elliott's modification of Poncetel's formula. Elliott's modification gives the formula the following appearance:

$$V = 48 \sqrt{\frac{d\,(h + \frac{1}{2k})}{l + 54\,d}}$$

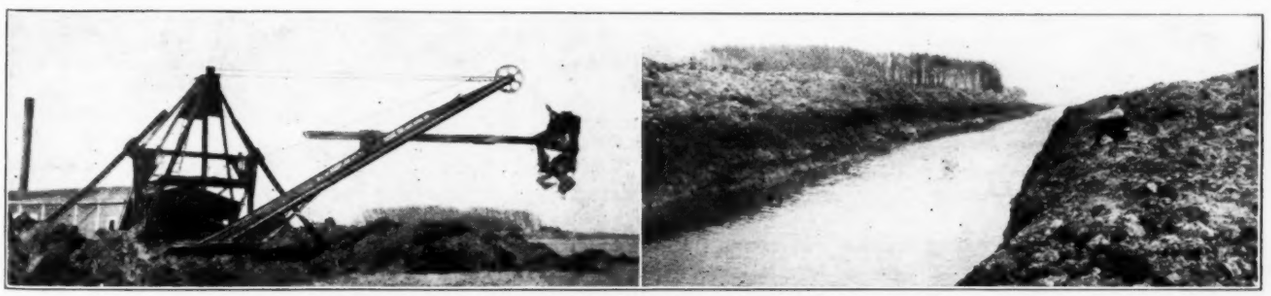
Where V equals velocity of flow in feet per second; d equals diameter of tile in feet; h equals head, or difference in elevation between outlet and upper end in feet; k equals cover on tile at some point, near head of same, where surface water will collect; l equals length of drain in feet. Quantity of discharge is of course equal to the area of tile multiplied by the velocity of discharge. Experience, however, has convinced the writer

LAYING 22 IN. DRAIN TILE IN 21 FT. CUT. AT THIS DEPTH TILE ARE LAID IN CONCRETE CRADLES AS A SAFEGUARD AGAINST CRUSHING.

that where the available grade for a tile system is 0.50 ft. or less—per 100 ft. station—the cross-sectional area of system should be increased somewhat.

For tile larger than 16 in., inside diameter, the constant (48) should be increased as follows: 18 in. to 53; 24 in. to 57; 30 in. to 60; 36 in. to 62; 42 in. to 64; 48 in. to 66; 60 in. to 68.

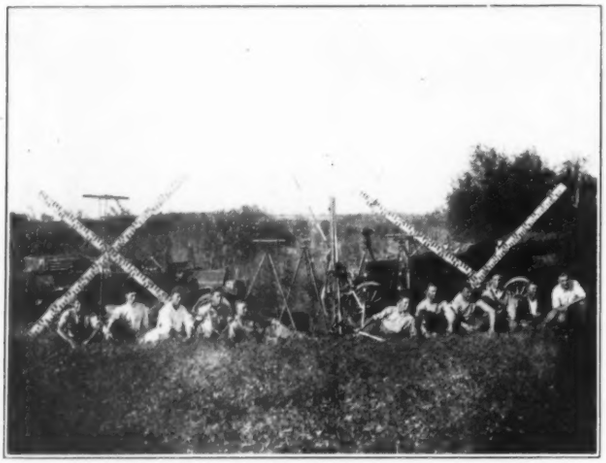
The laying of drain tile is not materially different from the laying of sewer systems except that the joints are intended to admit water to the system. Various mechanical excavators



VIEWS OF HEAVY LAND DRAINAGE OPERATIONS IN IOWA.
Floating Dredge Excavating Open Drainage Channel.—The Open Ditch: Machine Just Ahead which accounts for the High Water.

have been placed on the market, but have not met with a great degree of success, due chiefly to the fact that the necessarily heavy and ponderous machinery is difficult to operate in wet, swampy ground. The best equipment for properly laying drainage tile—according to our local wit—is "a good foreman, a good engineer, a gang of Norwegians with weak minds and strong backs, and an inspector whose only friend is his wife."

Some of the essential points to be noted in laying a drainage system are: Good close joints—joints that will permit the entrance of water, but exclude sand and soil; a fairly even grade—a rough grade cuts down the discharge area and adds an element of roughness; well-cemented junctions—the writer prefers field junctions to factory junctions, if the former are



VIEW SHOWING OUTFIT USED BY LAND DRAINAGE FIELD ENGINEERING PARTY.

carefully cemented; slow and regular curves rather than sharp angles; and, above all, sufficient depth—at least 4 ft. is good practice for this local district.

And now just a word as to the value of drainage. Within the writer's knowledge the highest local cost for draining a 40-acre tract will be about $100 per acre (this is an exceptionally wet tract). The value of this land when drained will be about $150 per acre, making the total valuation $250 per acre. Assuming that this tract will average 40 bushels of corn per season at $1 per bushel, the investment will yield $40 per season, or a profit of $25 per acre. This means a profit of at least 10 percent on the investment.

Land in this locality has risen in value from $30 to $150 per acre within the past twelve years, due chiefly to the fact that drainage has increased the acreage available for tillage by at least one-third.

New Pennsylvania Highway Commissioner Will Not Tolerate the Ripping Open of New Pavements

Lewis S. Sadler, recently appointed state highway commissioner of Pennsylvania, has declared that there will be absolutely no deviation from the rule that no permanent paving will be put down in boroughs of Pennsylvania, so far as the state highway department is concerned, until every pipe or sewer connection is made on the thoroughfare to be improved. This announcement is in line with Governor Sproul's determination that there shall be no waste of state highway funds.

"Before we proceed with the construction of permanent thoroughfares through boroughs of Pennsylvania," said Commissioner Sadler, "we will have agreements with the borough authorities which will prevent the ripping of pavements. And we shall insist that these agreements be lived up to. For not less than *five years* after completion the pavement may not be disturbed, unless in case of extraordinary emergency. We do not propose to waste money. I can conceive of no reason why the boroughs themselves, the corporations and private property owners cannot lay their sewers and mains of various sorts in anticipation of paving. I know of no reason why old mains cannot be removed, if necessary.

"In the case of vacant lots, where construction begins after the paving is laid, will the rule regarding sewers and piping be enforced?" the Highway Commissioner was asked.

"Most assuredly," was the reply. "Owners of properties should lay all necessary piping before we begin paving. They must anticipate construction.

"Many roadways in Pennsylvania which otherwise would have lasted for a great many years have been ruined in a comparatively short time because they were ripped up for the laying of piping. I know of instances where within a few months after completion of a long stretch of brick paving a public service corporation ripped the street for a distance of half a mile to put down a water main. This could have been avoided. It is not possible effectively to patch highways of the rigid type after they have once been cut through. In spite of all precautions taken it is never possible to get the same uniformity in the patch as was had in the original job. Lack of uniformity is one of the primary causes of early deterioration. That is demonstrated in the case of bituminous types where irregularities hold moisture and other foreign materials and cause disintegration of the paving. No element has as detrimental an effect on bituminous paving as water; and it is not possible to keep out water where a patch has been made. The surface must be kept true in order to assure a perfect roadway. In paving of other than bituminous kinds there is always a line of cleavage, as a result of which water creeps in and in times of freezing and thawing displaces the surface.

"For these reasons—because we will save the commonwealth many hundreds of thousands of dollars, we will not lay a foot of paving in any borough of Pennsylvania until every single water and sewer and gas connection, or underground connection of any other kind, has been completed.

"I mention this matter now because the spring of the year is coming and it will be possible for municipalities, public service corporations and individuals to do whatever street ripping is necessary. Once our paving is down it will not be disturbed."

Design of Concrete Sidewalks and Concrete Curb and Gutter at Street Intersections

By W. Robert Paige, Civil and Consulting Engineer, Terre Haute, Ind.

In 1917 the writer had charge of developing a large tract of ground belonging to the Deming Land Company of Terre Haute, Ind., into improved city property. The property lays within the city limits of Terre Haute, and is surrounded on two sides (the west and the north) by well developed portions of the city. Along the north side of the track, for a half mile, the Old National Road (now Wabash Avenue through Terre Haute) from Cumberland, Md., to St. Louis, Mo., runs south 78 degrees and 14 minutes west. As the intersecting streets were laid out due north and south, the lines of the walks and curbs intersect at an angle of 78 degrees and 14 minutes on the west side, and 101 degrees and 46 minutes on the east side.

The roadway of Wabash Avenue had been curbed with limestone curbing, and paved with brick. Street intersections from the north had been extended from the south curb to the south property line and paved. As these intersections did not meet the new streets in the subdivision, it was necessary to remove them and make the improvements conform to the new conditions. All other street intersections were practically at right angles. The roadway of the street along the west side of the subdivision had previously been curbed, but fortunately no openings had been left for street and alley extension.

Among the many interesting problems this improvement developed was the construction of concrete sidewalks and curb and gutter at street intersections. The tract being practically free from any improvements afforded an opportunity to adopt different plans from the stereotyped ones used by the city. For example, about 26 years ago the city adopted a standard curve at street and alley curb intersections of 6 ft. radius for the former, and 4 ft. radius for the latter. These standards have been, and still are, rigidly adhered to regardless of the great change in traffic conditions.

The Deming Land Company adopted a minimum curvature at street intersections of 15 ft. radius, and a maximum curvature of 40 ft. radius, and a curvature at all alley intersections of 10 ft. radius. These plans have been recently approved by the city.

Figure 1 shows a plan of an intersection of a north and south street with Wabash Avenue. The special feature is the construction of the curb and gutter at its intersection with the concrete walks. The inside lines of the concrete walks from opposite directions extended, intersect the curb lines at "A" and 'B." A straight line connecting these two points form the back side of the curb and gutter, the circular line of the back side of the curbing being eliminated in this section. This gives the appearance of a broad step rather than a curbing, which effect is very pleasing. An asphalt expansion joint 1 in. in thickness and 4¾ ins. in width is placed along the line A-B which separates the walk from the curb and gutter. A joint also extends through the curb and gutter at points "A" and "B".

Figure 2 shows the cross-section of the curb and gutter and the sidewalk through the diagonal E-F. It will be noticed that the thickness of the curbing along the line A-B is the same as at the curb line. The theory for this construction is that the resultant from the expansion forces of the two walks coming together from opposite directions is practically at right angles to the line A-B, and is greatest at "G", gradually diminishing to the points "A" and "B." We have, therefore, the greatest mass of concrete at E-G to resist the greatest pressure, and the mass diminishing as the forces diminish towards A-B.

The walks are also cut through along the lines shown on the plan. The diamond at the center is formed by extending parallel to the inside and outside lines of the walks, lines equidistant from the same. The walks are squared off at the end of the curves as shown on the plan, after which they are cut in regular blocks of 6 ft. in length.

Another special feature was the paving of the intersections. Instead of paving to the south property line of Wabash Avenue, as was the custom of the city, we started at a line C-D (Fig. 1), at right angles to the curb lines of the intersecting street, the point "C" being at the intersection of the gutter line with the south property line of Wabash Avenue.

The pavement was of the monolithic type, the brick being laid at right angles to the intersecting streets.

The pavement was started along the line C-D, and closed up along the line of the old pavement. This required just one line of bats along the old line of pavement, and leaves the line of the paved intersection in correct form for future extension when desired.

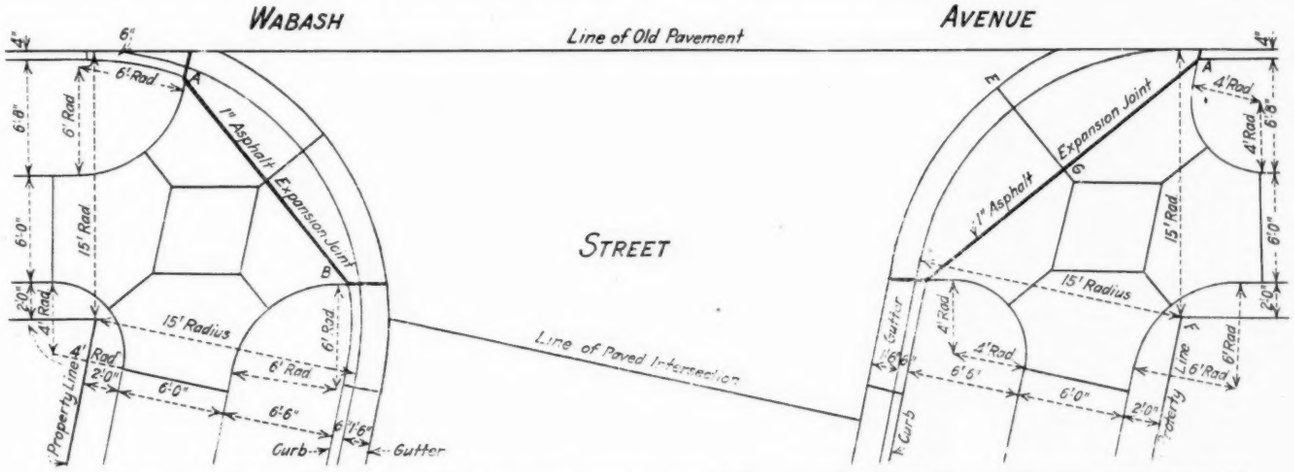


FIG. 1—PLAN SHOWING SIDEWALK AND CONCRETE CURB AND GUTTER TREATMENT AT STREET INTERSECTION.

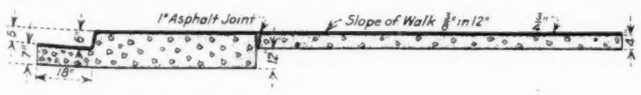


FIG. 2—SECTION THROUGH E-F OF FIGURE 1.

Figure 3 shows one of the four corners of the intersection of two streets, approximately at right angles with each other.

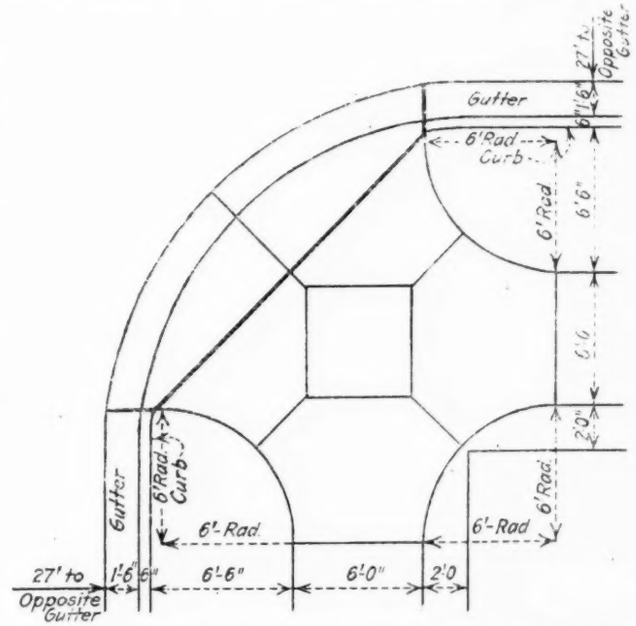


FIG. 3—TREATMENT OF ONE OF FOUR CORNERS OF TWO STREETS INTERSECTING ALMOST AT RIGHT ANGLES.

This plan was afterwards slightly modified by changing one of the walks from 6 to 5 ft. in width. This, however, did not materially change the form or appearance of the corners.

The Relation of Highways to Motor Transport Efficiency

By Arthur H. Blanchard, Consultng Highway Engineer, Broadway and 117th St., New York City

The efficient development of highway transportation through the means of the motor truck parcel post service, return load bureaus, intercity freight delivery, rural express and other methods of motor transportation, necessitates the utilization of highways during 365 days of the year and the construction and maintenance of good roads everywhere, said Mr. Blanchard, in addressing the Conference on Modern Methods of Motor Transportation, recently held in New York.

Economic Conditions

The practical development of this program calls for the expenditure of vast sums of money, at least one billion dollars annually. The cost of highways of the future is problematical. An indefinite period will elapse before the wages of labor and the cost of materials will be adjusted to normal conditions. These economic questions constitute a problem which must be given exhaustive consideration. One phase, upon which it is advisable for all to deliberate, is the sources of the unskilled labor so largely used in highway improvement. The world war has materially reduced the available supply in this country and the reconstruction of Europe will prevent the usual additions through the avenue of emigration.

Financing

Today there are in the United States 2,500,000 miles of rural roads, 12 percent of which are classed as improved. A conservative estimate would indicate that not more than one-fourth of 1 percent of the total mileage is suitable for motor truck trunk highway traffic. During 1917 there was appropriated for the improvement of rural roads $300,000,000. This work is under the jurisdiction of the Federal Government, the State Highway Departments, over 3,000 counties in the various States, and the innumerable townships. The scope of this brief resume will not allow a discussion of the methods of financing highway improvements, but it is advisable strongly to emphasize the indisputable fact that it is reckless financing to construct roadway surfaces, which will have a life of 10 years, with 50-year bonds.

For a National System of Highways

Today there is no national system of highways in the United States comparable to the world renowned national system of France. Indications point, however, to a rapidly developing sentiment and demand for the creation of a system of interstate highways aggregating between 50,000 and 150,000 miles, which shall be constructed and maintained under the supervision and at the expense of the Federal Government. Such systems of highways as we now have are practically developed through the individual or co-operative action of our State, county and township governments, Federal aid constituting a very small percentage of the total amount expended. The development of systems in many parts of the United States is in a chaotic condition, due primarily to lack of foresight and wise administration, local jealousies and ineffective laws.

Educational Work

Efficient and economical highway improvement has been seriously jeopardized in the United States through political interference and the placing of highway work in the hands of laymen who have had no experience in this important technical profession. Unfortunately, the public neither appreciates the character of the duties of highway officials nor does it take proper interest in the expenditure of its funds. The people must be educated with respect to the complex work for which highway officials are held responsible and the waste of public funds directly attributable to having highway work in the hands of laymen. It should be emphasized that the primary objects of the educational campaign advocated are: First, the economical and efficient expenditure of the millions of dollars annually appropriated for highway work, and second, the appointment of members of the highway engineering profession to the innumerable positions of responsibility in public life which demand the combination of administrative ability, honest character, and the technical knowledge, training and experience possessed by qualified engineers.

Standing of European Highway Engineers

As in the case of many public activities, it is practicable in connection with this problem to derive valuable suggestions from practice in foreign countries. A review of their histories indicates that they have passed through the same transition period which we are entering. In France, many years ago, the people and the servants of the people realized the advantages accruing from the establishment of a permanent organization of efficient, well-trained highway engineers, and hence there was created the renowned Department of Roads and Bridges of France. Passing across the English Channel, we find similar conditions in Great Britain.

In order to secure a dollar's worth for every dollar expended, the British public realized that it was necessary to have in control of their public works men trained in a profession directly dealing with every economic and engineering phase of public improvements. It has therefore inaugurated the practice of requiring that applicants for a given municipal or county position shall have attained the grade of membership in the Institution of Civil Engineers of Great Britain commensurate with the responsibility of the work of the particular office. Many leading municipal and county positions require that the applicant shall, first of all, hold the highest grade of membership in the Institution, while positions in small counties, towns and districts require in many cases associate membership.

It would seem desirable in this country that a step along the line of English practice might be taken, and, in the case of positions of highway officials, that there be incorporated in the constitution of a State or the ordinances of a city the stipulation that the applicant shall hold a certain grade of membership in the American Society of Civil Engineers and have had a certain number of years of experience in highway work.

Motor Traffic

The problems confronting the highway engineer of today are entirely different from those which existed 15 years ago. At that time the motor vehicle was not a factor. Today between 5,000,000 and 6,000,000 motor vehicles use our highways, 10 percent of which are motor trucks. Instead of constituting practically 100 percent of the traffic, as in 1903, horse-drawn vehicles at present amount to 5 to 20 percent on highways outside of urban districts.

Types of Roads

With the enormous development of motor truck highway transportation, which this country is to witness in the next five years, many established practices in highway work must be remodeled. It is self-evident that the increased tonnage will call for ideal drainage, strong foundations and roadway surfacings suitable for motor truck traffic. In this connection may be cited the recommendation of the former New York State Department of Efficiency and Economy, in 1915, that all trunk highways should be built with cement-concrete foundations. Dependent upon the amount and character of the traffic to which a trunk highway will be subjected during the life of its surface and other factors influencing its selection, the following types are suitable: Bituminous concrete, cement-concrete, brick and stone block.

Width of Roadway

As of particular interest to the advocates of the develop-

ment of motor truck transportation is the present condition pertaining to the width of pavements on trunk highways. Reviewing the construction of the past few years of the types of pavements heretofore mentioned used on trunk highways, it is found that the widths vary from 12 to 18 ft., with a few instances of greater widths. In this connection it is of value to note that the Highway Committee of the American Society of Civil Engineers recommended several years ago that "where motor truck forms a considerable portion of the total traffic likely to use a highway, the unit width of traffic lines should be considered as 9 or 10 ft., instead of 7 or 8 ft., as heretofore." Furthermore, as far back as 1908, the First International Road Congress, held in Paris, adopted this resolution: "There should be but one roadway for every kind of vehicle, 19 ft. 8 in. wide at least." It is, of course, well known that many of the main county highways of England have an improved surface of from 20 to 22 ft. and that the main trunk highways of France are practically 24 ft. in width. When the rapid development of touring car, motor truck traffic and motor bus routes are given consideration, it is obvious that our important inter and intra-state trunk highways should have roadway width of not less than 20 ft.

Other factors in the construction of highways, which must be given careful consideration during the next few years, are strengthening of highway bridges, grades, location and alignment of highways, adequate guard rails, and uniform highway signs.

Efficient Maintenance

The people of the United States are beginning to appreciate the fact that in order that value is received for the money expended in the construction of highways it is necessary that the highways should be efficiently maintained. Some method must be devised by which the legislatures shall annually appropriate sufficient funds to maintain improved highways properly and economically. Legislature after legislature has followed the procedure of discounting the estimates submitted by highway departments. Hundreds upon hundreds of miles of highways are today improperly maintained, due to a lack of funds. It should be borne in mind that if maintenance is curtailed in one year in a given state to the extent of $500,000, and miles of highways are thereby left unrepaired, the appropriation required in the following year to repair the damage to the highways not maintained may amount to a million dollars.

Uniform Highway Traffic Laws

It is of vital import that uniform highway traffic laws should be placed on our statute books. Such laws must cover the physical factors and the operation of all types of vehicular traffic. Laws will be based on available data and opinions. There are, at present, innumerable investigations which should be made to ascertain facts pertaining to the interrelationship of motor truck traffic and the durability and serviceability of highways. If highway departments do not conduct such investigations, they should be undertaken at once by motor truck interests. If the essential data is not available, naturally traffic laws will be based upon conservative conclusions reached by highway officials and members of our legislative bodies.

Shortage of Road Contractors in South Dakota

To the Editor:

"South Dakota has available for the next two or three years $11,250,000, besides county levies which foot nearly $2,000,000 and auto funds of nearly $1,000,000 for maintenance. So you can see that the people are thoroughly imbued with the good roads idea.

"The legislature which recently finished its session passed a law authorizing a $6,000,000 bond issue, besides giving us over a half million by direct appropriation. We also have a new highway law, which we consider a very flexible law, granting plenty of power to the new commission.

"We are shaping our program for a very busy summer. Our only drawback will be a shortage of contractors to carry on the projects. We can prepare for them with our efficient office and field forces."

Very truly yours,

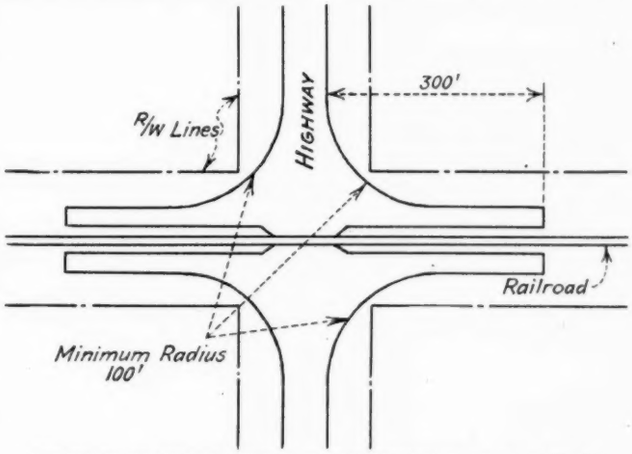
FRANK S. PECK, Highway Engineer,
South Dakota State Highway Department.

Pierre, S. D., March 20, 1919.

Engineering Treatment of Necessary Railroad Grade Crossings

By Rodman Wiley, Commissioner of Public Roads of Kentucky, Frankfort, Ky.

When travel was mostly by steel tired vehicles, the danger at crossings was at a minimum, and naturally the question did not receive, and was not expected to receive, the consideration it does today when most men are endeavoring to save time and make money, and the majority of the travel is by automobile and automobile truck. In order to take care of this new



SKETCH ILLUSTRATING ENGINEERING TREATMENT OF HIGHWAY AND RAILWAY GRADE CROSSING.

method of travel, the highways are now carefully planned, particular care is being taken to see that the proper type of surfacing is used, wide, strong and expensive types of bridges are being built, but the grade crossings are receiving practically no attention.

Highway Rights Ignored

It has been customary for some years when one railroad crossed another railroad company's track for the one desiring the crossing not only to receive permission from its senior but to furnish the necessary frogs and install all interlocking signals. The same is true when interurban lines cross railroad tracks.

We know it is impossible to span a navigable stream with either a highway or railroad bridge without first receiving a permit from the Federal Government. The government specifies the length of span and the height the bridge must be placed above low water; in other words, the government appreciates the fact that neither of the other two systems of transportation should interfere with the safe passage of boats; yet until very recently it was known to be an almost unheard of thing for highway officials to be consulted when a road was to be crossed by either railroad, interurban or street car lines. In many instances such crossings have been made without even installing danger signals.

In the majority of cases crossings are treated the same today as ten years ago, and it appears that the principal cause of the trouble has been the lack of attention not only on the

part of the officials, but by the people, which naturally implies the lack of engineering advice.

Precautions Taken at Grade Crossings

Statistics show that the railroad companies pay out considerable sums of money because of accidents and deaths at grade crossings. Naturally such corporations endeavoring to reduce their expenditures to a minimum, and especially to save *human lives*, have installed all sorts of safety devices, a great many of which are absolutely ignored by the public. We now find stationary electric bells in some cases, swinging electric bells in others, electric lights and finally at the most important places we see gates and watchmen.

Considered from a purely financial standpoint, very few railroad crossings are properly maintained so that a machine is damaged each time it passes over one. Suppose that the damage to a machine amounts to only one cent and that a hundred machines pass that crossing in a day. That means that damage has been done to the extent of one dollar per day or $30 per month, $360 per year, which is the interest on $6,000.

Grade Crossings Are Usually Unavoidable

I take it that necessary grade crossings are made so because of great difficulties which would be encountered in eliminating them. Such things as the topography of the country, rights-of-way trouble, damage to property and, in its final analysis, lack of funds, because certainly the majority of crossings are unnecessary provided the money is available to eliminate them.

It makes no difference what is suggested, there will always be accidents so long as we have grade crossings, and anything that is done is merely an insurance against death or accident and the first question would most naturally be, who should pay the bills? We find that when either a highway or railroad company crosses a river, which is navigable, they pay the bills, and when one railroad company crosses another, the junior company pays the bills; the same is true of interurban lines crossing railroad tracks.

Responsibility for Grade Crossing Accidents

One might naturally think that the railroad grade crossing question should be handled in the same manner. The railroad company, however, being a corporation, is liable for damages and should and perhaps would in most cases be willing to pay part of the cost, even though they might have priority claim at the crossing, but certainly if the people are determined to travel at a greater rate of speed so that their lives are more in danger than they have been in the past when most grade crossings were allowed to come into existence, and especially when human nature and human carelessness enter so much into the proposition, the public should pay some part of the cost. It should be remembered that the people, not the railroads, have changed their method of travel.

No two men behave exactly in the same manner when crossing a railroad track. A few will stop and listen for approaching trains, others will slow up their machines and look hurriedly to the right and left, but the majority will plunge headlong over the track without taking any precautions whatever, and certainly no concern should be penalized for the lack of attention paid to all warnings, especially when the railroad is a necessity and is rightfully allowed to exist under the laws of the country.

The highest courts in many of our states have refused to give judgment against railroad companies because the drivers of automobiles have not exercised reasonable precautions in crossing railroad tracks.

It is a question of human life against money, and I venture to say that very little will ever be done until the public appreciates the value of a human life. All sorts of excuses will be given and accepted because in order properly to protect their own lives and the lives of their fellow men, the people would have to pay a little more taxes.

Engineering Recommendations

Some engineers after carefully studying the question have recommended that the highway on each side of the railroad track should be made straight and level for some distance back of the track. That, of course, is a great precaution, and would tend not only to prevent accidents from collisions with trains but it would also tend to prevent accidents on the highways, as sufficient sight distance would be provided. Others recommend all sorts of electrical devices and interlocking signals to warn men that a train is within a certain distance of the crossing.

All electrical devices, however, are liable to get out of repair, and might not in isolated districts receive attention for many days. In such cases, no warning would be given in the interim, so we cannot depend entirely upon such things.

Because most accidents are due to the speed at which automobiles are driven, there should be a national law preventing any manufacturer under heavy penalty from making any pleasure automobile that can attain a greater speed than 30 miles per hour, and then every driver can keep his car under control.

Relocation

Considerable danger could be removed if a great many of the roads were relocated and that could be done in a great many instances. Where a road parallels a railroad for some distance before crossing, the road should, if possible, be at least 300 ft. from the track and the crossing should, if feasible, be made at right angles to the track. In addition, all obstructions to the view should be removed so that when a man makes the turn preparatory to crossing the track he can see both ways up and down the railroad for some distance.

As an added precaution, it would be well to build a road parallel to the railroad track for a distance of perhaps 300 ft. each side of the main road, and, in all probability, it should be on the railroad company's right-of-way. The surface of the road should be at the same elevation as the top of the rails; in case a man saw he could not clear the track, or in other words that he was caught, he could turn, either to the right or left, off the main highway and run his car parallel to the track and prevent a collision.

Of course such things as electric lights, electric bells, etc., should be used in all cases because they always serve as a good warning.

Specific Recommendations

Important crossings should be well paved, the paving to be level with the top of the rails so as to prevent a man killing his engine on the track; also to save the wear and tear on vehicles.

Less important crossings could be paved with timber, say 2 ins. thick, set on edge, sized so as to make it level with the top of the rails, the timber to be nailed to ties and to each other and all points of contact to be tarred. This would make a rather inexpensive improvement and it is believed the results would be admirable as 2x4s spiked together and tarred have been used very successfully as flooring for bridges in Kentucky.

As a general proposition, it would be well, as has been advocated, to make the road straight and level with the top of the track for a distance of at least 300 ft. each side of the center line of the railroad and to have all obstructions such as brush, high banks, etc., removed so that a man can see both up and down the track when traveling any part of the 600 ft.

Inasmuch as crossings might be divided into several classes according to their hazardous nature and volume of traffic passing over them, it might be well for representatives of the railroad companies in the various states to meet with the proper highway officials, take a census of all crossings and divide them into classes. At the most hazardous or otherwise important crossings from a standpoint of travel, in addition to

doing all that has been said, it might be well to have gates and watchmen.

Sufficient precaution should be taken either in the way of making such changes as have been advocated or else the driver of a vehicle should be required to stop and walk across the track before attempting to drive across.

A street intersection in a busy town might be considered a necessary grade crossing. It is not, of course, in all cases a railroad crossing, but is subjected to a great volume of traffic. We find that soon after the advent of the automobile, the police departments in practically all towns had watchmen stationed at the intersections to take care of the traffic.

An examination of the practice of street car companies and interurban companies in crossing the railroads shows that almost invariably the street cars or the interurban cars are required to stop on one side of the track, the conductor crosses the railroad track and signals the car ahead.

I know that complaints would be made by the autoists because of the time required to stop their machines and walk across the tracks, but when a man attempts a journey in an automobile he is aware of the fact that he will, in all probability, have punctures and blow-outs and he is willing to take his chances in order to save time, and travel when it suits his convenience, and certainly if he is willing to repair two or three punctures in the course of a journey in order to go as he pleases, he should not complain if a few minutes of his time are taken up endeavoring to save his life.

The public should appreciate the fact that no precaution on the part of any railroad company will save a man's life if he is determined to be a fool.

Acknowledgment

The foregoing discussion is the major portion of an address delivered before the annual convention of the American Association of State Highway Officials.

Proper Regulations Governing Private Fire Protection Water Service Lines

By Dow R. Gwinn, President and Manager, The Terre Haute Water Works Co., 634 Cherry St., Terre Haute, Ind.

In considering fire protection, there should be no confusion between that which is furnished by the municipality, known as public fire protection, and that which is for the exclusive use of an individual, or manufacturing concern. In the first case, the pipes and hydrants are on public streets, while in the second case, large pipes are laid into private grounds and buildings to which are connected fire hydrants, automatic sprinklers, and stand pipes.

The manufacturer who desires something more than the public fire protection should, of course, pay for private protection of a special character.

A comparison could be made with the public police protection furnished by the municipality and that of a manufacturer paying for a private watchman or policeman. The municipality provides fire and police protection of a general character for the public. If special protection of a private character is desired, the cost is met by those who enjoy the special privileges. It is not necessary in every case to connect with the city water mains to enjoy private fire protection.

Special Fire Protection by Independent Plants

This protection can be provided by means of independent or local equipment, such as fire pumps and elevated tanks. A number of manufacturing concerns now provide their own special fire protection in this way and in such cases, they pay the actual cost of it. This cost includes interest on the investment, depreciation, repairs, taxes, fuel used in maintaining steam, extra labor in looking after fire pumps, and also additional labor on Sundays, holidays and at such times as the factory may be shut down. It has been estimated by an insurance expert that the cost of such special private fire protection, when furnished by the manufacturer, would amount, in one particular case to approximately $600 per annum.

Special Fire Protection Connected With Public Water Supply

This service is furnished in cases where the manufacturer does not wish to make the investment for fire pumps, etc., and to employ men to keep up steam on holidays, Sundays and such times as the factory may be shut down.

Connections with public water supply should not be made with private pumping plants having other sources of supplies than that furnished to the general public. Typhoid fever epidemics have resulted in several cities on account of private fire lines being connected with the public water supply and also with contaminated sources through private fire lines. In the city of Lowell, Mass., I understand there were about 25 deaths; in Auburn, N. Y., there was a small epidemic; in Rockford, Ill., there were 40 deaths, although it is said that it was not clearly proven that the fire line connection was to blame. It is reported that typhoid fever epidemics have been caused by fire pumps draughting from polluted sources and seeping through leaky check valves into public mains at Sheboygan, Wis., and Morris, Ill. The public health is of such great importance and human life is so precious that no connections should be made between the public water supply by means of private fire lines and other sources of supply.

Where connections are made with a public water supply for private fire protection, there is a menace to the balance of the city on account of danger of broken sprinkler pipes. There are a number of cases on record where the automatic sprinklers have failed to control the fire and falling walls have broken the large supply pipes, making it impossible for the water works to maintain adequate fire pressure. With a 6 in. supply pipe discharging a full stream, it would be practically impossible for the average water works plant furnishing water under direct pressure to supply adequate fire protection for a second fire in case one should break out at that time. The result of a broken sprinkler pipe might mean a serious conflagration and destruction of a large portion of the city.

It is the opinion of the author that insurance companies will realize this menace before many years have passed and will discourage if not prohibit large connections between the water mains and automatic sprinklers. At the present time, the Committee on Fire Protection of the National Board of Fire Underwriters recommend in congested valued districts, a supply of 7,500 gals. per minute in excess of the domestic consumption and state that this includes an allowance for loss from broken services, elevator, and sprinkler connections incidental to a large fire. This means that in order to provide fire protection which is considered adequate by the underwriters, it is necessary for the water department or company to provide equipment and mains sufficient to take care of a demand on account of broken sprinkler connections. This means an extra investment or cost to the water department or company. If such connections are furnished, the water department or company should receive just and reasonable compensation for such special service.

There should be no question in regard to the right to furnish this service by meter measurement and there should be no connections allowed unless the same are provided with meters. The meters for this purpose should, of course, be subject to the approval of the water department or company. In most cases they should be meters which have been especially designed for fire lines, although there are cases where a compound meter would be satisfactory.

1. *Suggestions for Compensation*—On the basis of the saved insurance premiums. These savings due to automatic sprinklers amount, in some cases, from $1,800 to $3,000 per annum. If the water department or company furnishes the service by which reductions in insurance rates are made, the compensation should be adequate. The reduction in insurance

rates on account of automatic sprinklers in one particular case was from $1.60 per hundred to 20c.

2. The compensation should be equal to the cost to the consumer if such special fire service was furnished independently. This will, of course, include interest on investment, repairs, taxes, fuel, extra labor, etc.

3. Compensation to the water department or company on account of large mains, additional equipment, etc., necessary to provide adequate service to the manufacturer and also for maintaining pressure and standing guard over premises of the manufacturer; under this arrangement, there should be a minimum meter rate on the basis of size of the meter, in proportion to the minimum rates charged for ordinary house meters. Where the water department is standing by, maintaining pressure on the premises of the manufacturer, the compensation should be adequate for such unusual and valuable service.

Rules for Private Fire Protection Lines, Installation of Service, Etc.

1. All private fire protection services will be installed by the company, which will ascertain the best location for them, and lay the pipe from the street main to a point just inside the wall of the building, or within the building line of open yards, where buildings are set back from the building line. The consumer will be charged for time and material, plus 10%.

2. *Size of Service Pipe, Underwriters' Pump*—In all cases, the company shall decide the size of the service pipe. In all cases where underwriters' pumps are to be installed, a suction pipe of sufficient internal area to deliver a quantity of water equal to the full rated capacity of the pipe will be allowed, and no enlargement of said suction pipe inside of the premises will be permitted. If, however, this service pipe is run to a surge tank placed in close proximity to the pump, the full size of suction which the pump calls for may be run from the pump to the tank.

3. *Number of Services*—One service only will be allowed to any one building or premises, unless in the opinion of the company, the general or public fire protection will not be jeopardized and more than one is absolutely necessary for the proper protection of the premises. All fire equipment connected to the company's service shall be confined within the building or on the premises named in the application, and where two or more connections are made for one building or premises, they shall be kept separated, unless special permission is obtained from the company to connect the same in a manner to be approved by it.

4. *Test of Fire Services*—Whenever a fire service system is to be tested under the regulations of the fire insurance underwriters, the consumer must notify the company of such proposed test, naming the day and hour when the same is intended to be made, so that, if desired, the company may have an inspector present during the test.

5. *Contamination of Water Supply*—Any fire protection system supplied with water from the company's service shall be supplied exclusively with such water, and no connection will be allowed with any other system drawing its supply from any other source whereby the company's water supply may be contaminated by the failure to close valves, or leaking check valves, etc., and no auxiliary or secondary suction pipe to any underwriters' pump taking water from wells, streams, or other source whatever, will be permitted. Any fire protection system using water from such wells, streams, or other source than the company's service shall be kept separate from any such system supplied from the company's service.

6. *Inspection*—All fire services shall be subject to inspection by the company from time to time, and the consumer shall give the inspectors all reasonable facilities for making the inspections, and any information concerning the same that the inspector or the company may require. Care will always be taken that inspections will be made with as little inconvenience to the consumer or occupant as possible.

7. *Approval of the Chief of Fire Department*—All applications for private fire protection shall be subject to the written approval of the chief of the fire department of the city, who in such approval, shall state that, in his opinion, the public fire protection will not be endangered by the connection proposed to be made by the company, when properly safeguarded by the placing of an indicator post valve as near the main as possible, said valve to be under the control and orders of the chief of fire department at time of fires, with full authority to close said valve.

8. *Guarantees*—The company, or department, in no manner guarantees to furnish a proper quantity of water through fire protection services, nor does it undertake to guarantee anything relative to such service, but it will endeavor to maintain the efficiency of its service under all conditions. The granting of a permit for private fire protection is under the express condition that the company shall not be considered or deemed in any manner to have undertaken to extinguish fire or to protect any person or property against loss or damage by fire or otherwise, the said company not being an insurer of persons or property, and that it shall be free and exempt from any and all claims for damages on account of any injury to persons or property by reason of fire, water, failure to supply water or pressure, or for any other cause whatsoever, and that in the event of the destruction of the premises of the consumer, then the contract between the company and the consumer shall immediately cease.

9. *Plans and Drawings*—The consumer will furnish an accurate sketch showing the pipes, valves, hydrants, connections, and appurtenances on the premises of the consumer and connected with the mains of the company and also an accurate sketch of any other water pipe system and fixtures that may exist on the premises.

References to Court Decisions Concerni g Private Fire Protection

"The principal subject of the defendant's water board in requiring fire service pipes to be metered is to prevent the surreptitious or careless withdrawal of water through such pipes for other purposes than the extinguishment of fires; another object is to procure the measurement by meter of all water consumed for any purpose in order to check wastage and to require each taker to pay for the exact quantity of water furnished to him. * * *

Both upon principle and authority we are of opinion that under circumstances like those before us it is not unreasonable to require the installation of a meter at the plaintiff's own expense in its private fire service pipes.

Nor can it be said that this regulation imposes undue burden upon the plaintiff. The defendant has afforded reasonable means of extinguishing fires by public hydrants; if the plaintiff desires in addition a private system for the protection of its own buildings, it is not unfair for the defendant to impose, as a condition of supplying without other charge, water to make this system available, the requirement that the plaintiff shall take this water only through a meter to be put in at the plaintiff's expense."

Shaw Stocking Company v. City of Lowell. (Supreme Judicial Court of Massachusetts; Middlesex. May 22nd, 1908. 85 Northeastern Reporter, 90).

"These authorities are cited to show the views of courts of high authority, and for the further reason that they are in harmony with the conviction of all men who have thought seriously upon this subject. There is no perceptible reason why the water company should be compelled to provide and maintain a sufficient supply of water to operate the water sprinklers in time of fire for private individuals, without compensation. On the contrary, this special benefit to the property owner over and above what the municipal fire protection affords the people in common, should be paid by the private user."

Indiana Public Service Commission in the case of Commercial Club of Terre Haute vs. Terre Haute Water Works Company, decided Dec. 18, 1915.

"The proprietor of a building, who installed therein an automatic sprinkler system, intending thereby to put out fires before they could gain headway, derives benefit from the system in fire protection and reduced insurance rates, and though there be a general benefit in reducing fire hazards, yet a municipal water works system to which the sprinkler is attached performs a service, and stands ready to perform others for which charges may be made.

It is evident that payment for the small quantity of water used would be wholly inadequate as compensation for the pressure required, and the readiness at all times to serve and the inspection of the city which might well be exacted."

Edgerly vs. City of Ottowa, 156 N. W. 388, decided Feb., 1916, by the Supreme Court of Iowa.

Action to restrain city from placing a meter on fire extinguishing plant dismissed by Appellate Division of the Supreme Court. Judgment affirmed with costs.

American Mfg. Co., Appellant v. City of New York. Court of Appeals of N. Y. Jan. 27, 1911.

"A water company which supplies the pressure and water for an automatic sprinkler for a private corporation performs a service which is not included under its contract with the city to supply water for fire protection and has the right to make a reasonable charge therefor against the corporation."

D. B. Loveman Co. vs. City Water Co. 1 Tenn. Ch. App. 596.

"In the matter of furnishing water to its citizens, a city when authorized by its charter acts in a private rather than a governmental capacity and has the same right to make reasonable charges therefor that a private corporation has when serving the public."

St. Louis Brewing Ass'n vs. City of St. Louis, 140 Mo. 419—37 S. W. 525, 41 S. W. 911.

"A rule, providing that water meters might be installed at the pleasure of the water board on the consumer and that after they had once been installed, the consumer could not thereafter return to the flat rate, is reasonable and may be enforced where the meter rates are reasonable and no discrimination between consumers is shown."

Powell vs. Duluth 97 N. W. 450.

"The law imposes no duty to insure the property or extinguish fires."

Woodberry vs. Tampa Water Co., 57 Fla. 243, 49 So. 556.

The Arizona Commission in fixing rates to be paid to a water company, decided that a mining company desiring a private fire protection system, should be required to pay a fixed demand charge although "the actual water consumed for this purpose is likely to be negligible."

Arizona Corp. Com. vs. Morenci Water Company, Public Utilities Reports, 1915, C. 525, 527.

"A great deal has been written upon the subject of charges for private fire protection, such as service for inside private hydrants and sprnkler systems. It seems to be the consensus of opinion of operatcrs that a minimum charge is entirely reasonable based on the idea of the "ready to serve" proposition. It is obvious that a manufacturing establishment or other business installs such private fire service equipment for the special security of its own property over and above the protection undertaken by the water company for the benefit of the public. For this reason it might be equitable to assess some charge for this service varying with the size of the connection. In the present instance, it appears that the water utility will be justified in metering all services installed for the purpose of such protection, not with the idea of charging for water used in case of fire, but for protection against surreptitious use as close inspection and supervision have been found in many cases to be inadequate."

Beloit vs. Beloit Water, etc., Co., Public Utility Reports, 1915, B. p. 1005, 1020.

"We do not doubt the power of the city, through the Board of Water Commissioners, to select water meters and install them in residences at the expense of the consumer. It is a matter of common knowledge that where water is supplied without limit, at a stated price, many consumers waste it. The knowledge that the quantity used will not affect the price, begets indifference and encourages negligence. Nothing affords a better check on this fault of a large part of the human family than self-interest. So, therefore, the installation of devices through which it may be known what quantity of water a person uses and whereby he may be required to pay in proportion to the quantity, are considered to be reasonable regulations. The good effect of such regulation is double. It leads to the payment of each person for the quantity he consumes and it protects the general supply."

Mallon et al. vs. Board of Water Commissioners, 128 S. W. 764.

"The benefit received was not incidental, but it was the result of a direct appropriation by the furniture factory of power and water, which was the property of another, as a standing guard over its property against the peril or destruction by fire. Connection with a light or water plant accompanied by the asserted right of using it and the means of exercising the right is a benefit enjoyed at the hands of another imposing an obligation to make reasonable compensation although the occasion for actual use never arises. Here there was not only the connection, the asserted right to use it and the means of exercising the right affording continual protection against fire, but there was a positive saving of insurance bestowed upon the furniture factory by the water company. The fact that there was no use, no actual consumption of water, is a factor to be considered in estimating what should be the amount of compensation, but it does not relieve the furniture factory from liability for the fire protection furnished at the expense and labor of the water company."

Cox v. Abbeville Furniture Co. 54 S. E. 830.

"So long as water supplied for protection against fire is a purely public service, under the control and management of municipal authorities generally, and under the fire department specifically, no direct charge to individuals is proper. When, however, a sprinkling connection is made with private premises the situation is materially different. These premises and the primary causes of catastrophe to the building and of the consequent possible use of disastrous quantities of water are primarily under the control, not of the public, but of the owner. A peculiar personal service is provided for his benefit, which is not enjoyed in common by the community in general, but is available only to a limited class of individuals. It does not advance the reasoning in this connection to split hairs between the 'use' and the consumption of water. As a matter of good sense the property owner beneficially employs the water mains for his own purposes and to his own advantage, although he may not, except in case of fire, actually draw any water from the pipes. It is necessary and proper that for this he should pay. In effect he gets something of pecuniary value from another, which that other is not compelled to give except on the basis of contract. That the law requires the terms of that contract to be reasonable and impartial or that advantage is mutual and involves no expense, is merely incidental or collateral. The conclusion is reached that a charge can be made. How great that charge should be in the view here taken is not before us."

Gordon v. Doran, S. L. R. A. (N. S.) 1049. The same case is reported in Ill., N. W. 272.

Acknowledgment

The foregoing paper was presented at the recent annual meeting of the Indiana Sanitary and Water Supply Association.

Automatic Device for Dumping and Righting Tiltable Cars

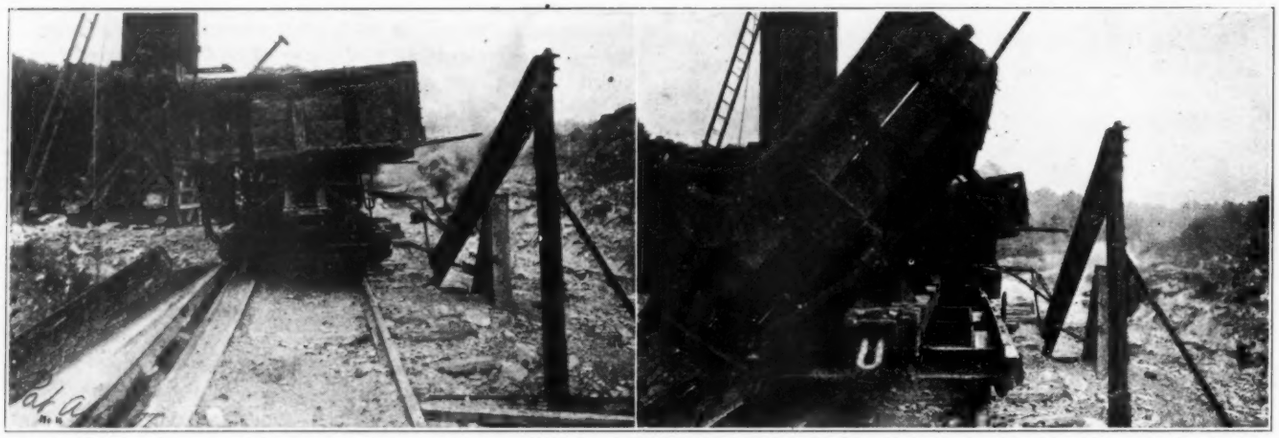
The dump car here illustrated is equipped with an automatic device for dumping tiltable cars upon their reaching a certain desired position, and for righting the cars upon their being moved away from this predetermined dumping position. The cars are normally held against possible accidental tilting. The dumping mechanism is of simple structure and may be added to the various types of dump cars on the market with but slight structural modifications. The device is known as the Druecker Automatic Dumping Device. It has been thoroughly tested out under service conditions and has fulfilled expectations. It is both a time and labor saver.

This device can be placed on cars up to 16 cu. yds. capacity, and it is claimed that four cars can be dumped in from 9 to 12 seconds and righted again and made ready for loading in five seconds.

It is especially interesting to know that the train of cars does not come to a stop during the operation. The dumping point can be shifted in about 10 minutes' time. The dumping mechanism is actuated by the tripping device set in the ground at the side of the track, which pulls a "trigger" in the mechanism attached directly to the car. As the car moves along the track, the dumping mechanism on the car, striking the fixed dumping rail at the side of the track, first dumps the car and then rights it again.

This device, for dumping industrial cars, is sold by the American Investment Company of Washington, D. C., and is the invention of Joseph M. Druecker, Kokomo, Indiana.

In the two views shown herewith, the mechanism is clearly illustrated. The views illustrate, respectively, the position of the mechanism and of the car body before and after dumping.



VIEWS ILLUSTRATING BEFORE AND AFTER DUMPING POSITIONS OF INDUSTRIAL CAR, EQUIPPED WITH BRUECKER AUTOMATIC DUMPING, RIGHTING AND LOCKING APPARATUS.

The One-Man Collapsible Culvert Form Proves Successful in Actual Use

A new culvert form, called the One-Man Collapsible Culvert Form, was briefly described in the February, 1918, issue of this magazine. At that time the form had given promise of success and was endorsed by its early users. The manufacturers made strong claims for the use of this form as a saver of time, money and material. These early promises have since been fulfilled, and numerous county engineers, county surveyors and county and township highway officials have given their full endorsement to this culvert form after giving it a thorough trial in their localities.

The One-Man Collapsible Culvert Form comes in four sizes, with which 91 different culvert openings can be made. It derives its name from the fact that it can be handled and collapsed by one man. It entirely eliminates the use of wood bracings in the building of concrete culverts with either flat slab tops or arched roofs.

The forms, which are made of steel, come in four sizes covering cross sections of from 13 x 16 ins., to 60 x 70 ins. For larger culvert openings two forms may be placed abreast or stacked. For a 30 ft. length four sections are used, spaced 4 ft. apart. If a concrete bottom is desired the concrete is mixed stiff and supporting planks are laid on the green concrete. When building culverts too small for a man to enter wires are attached to the cross rod and center bar in order to collapse the frame and remove it from the culvert. To keep the lumber and forms clean, tar paper is laid over the forms before depositing the concrete.

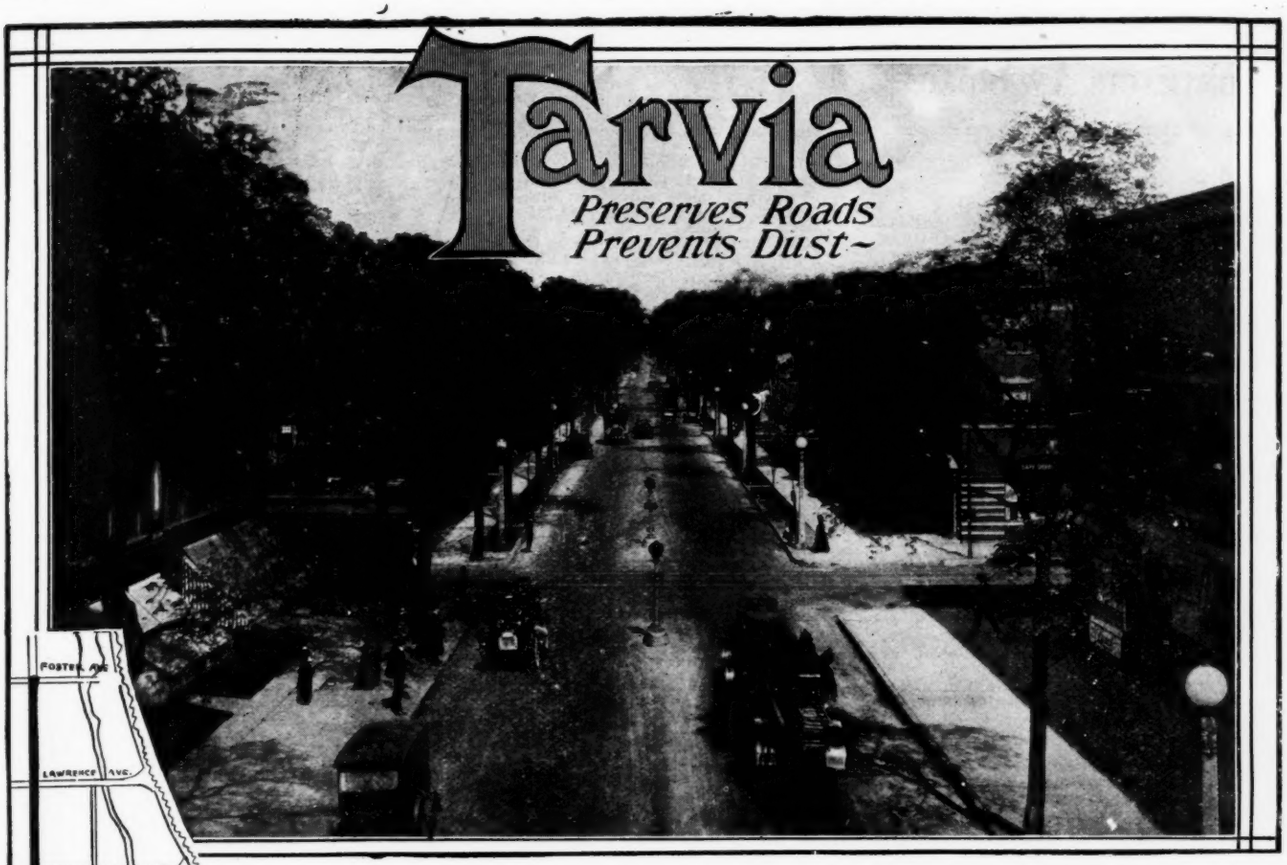
Experience has demonstrated that by the use of this culvert form box-shaped concrete culverts can be built at a saving of 25 to 50 per cent. as compared with the cost of building the same culvert, using wood bracing which must be sawed, fitted, nailed up and finally torn out after the concrete has set. Not only does the use of this form save time, labor and lumber costs, but because of its strength and dependability prevents the cracking of the concrete.

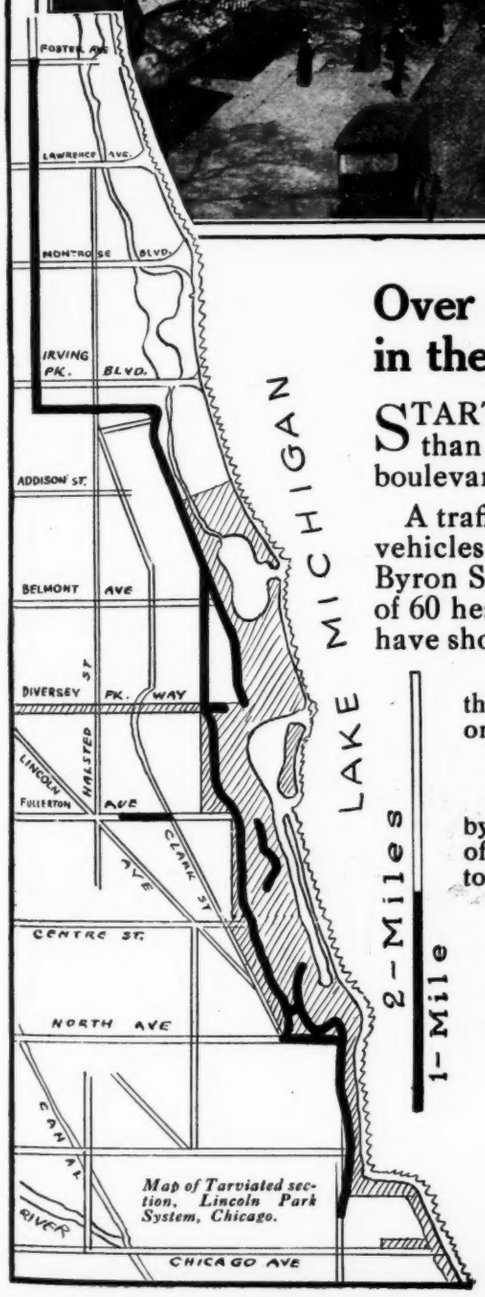
Like other successful equipment and devices available to the builder, this culvert form is a development based on experiments. It was placed on the market to decrease the expense incurred in using wooden forms over which to pour concrete culverts. This metal support can be used many times. If handled properly it will last indefinitely. Experiments were at first made with sheet metal for a casing, but it was found that such a casing would sag. There were other objections to the use of a metal casing, so it was finally decided to use lumber as a casing, as it is available everywhere and is much more satisfactory in every respect than a metal casing. The collapsible steel form work used in conjunction with the lumber casing is made in sections and every section is complete in itself. A section has no loose parts, separate trips, screws or braces. These culvert forms are the invention of George W. Storms, and are manufactured and marketed by the Storms Manufacturing Company of Crawfordsville, Indiana.

The form is made entirely of steel, reinforced, and is so constructed that it will rigidly support a great weight without slipping or buckling. By an easy pull on the control rod it will collapse and can easily be withdrawn from a culvert by one man. It takes only a few minutes to place the form and lay the wooden casing over it. It can be operated by unskilled labor. The time, labor and money saved on the first two jobs often pay the cost of a set of these forms.

Tarvia

Preserves Roads
Prevents Dust





Map of Tarviated section, Lincoln Park System, Chicago.

Over 6 miles of Tarvia-surfaced Boulevards in the Lincoln Park System, Chicago—

STARTING just above Chicago Avenue you can ride over more than six miles of smooth, firm, mudless, dustless Tarvia-surfaced boulevards, as shown by the black lines on the map at the left.

A traffic census taken on Sunday, July 21, 1918, showed that 10,700 vehicles passed over the Sheridan Road section of this boulevard, at Byron Street, between 10 A. M. and 7 P. M., including an average of 60 heavy double-decked buses every hour. Other traffic counts have shown as high as 12,800 vehicles in a single day at busy points.

This traffic is mostly automobiles, and for several months in the year the majority of them are equipped with tire chains, which are very hard on any road surface.

The weight of this daily traffic is estimated at more than 16,500 tons!

Such traffic would quickly ruin an ordinary macadam boulevard, but by treating the Lincoln Park System boulevards with Tarvia, the Park officials have been able to maintain a road-surface that is strong enough to stand even the tremendous strain of this heavy traffic.

Tarvia is a coal-tar preparation that makes roads smooth, dustless, mudless, water-proof, frost-proof and automobile-proof. It is made in several grades for varying road conditions.

Over a period of years Tarvia roads are less costly than any other form of good road construction.

Write for illustrated booklet and further information.

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CONTRACTS AWARDED

ROADS AND STREETS

Ala., Athens—J. W. Black, Columbia, awarded contract for paving various streets at $152,000; F. Nicholson, Columbia, awarded contract for curbing at $6,000.

Ark., Clinton—S. Woodsmall, Shirley, Ark., awarded contract by Van Buren Commrs., to construct 24 miles of road, at $100,000.

Ark., DeQueen—R. E. Martin, DeQueen, awarded contract to construct 18 mile gravel road, at $125,000.

Ark., Forrest City—Jos. McCoppin, Little Rock, awarded contract for paving which calls for concrete street with 5 in. base on all principal business streets, curbing on either side. Residence streets included in Dist. will be paved with concrete from 12 to 20 ft. in width. Bonds to amount of $100,000 sold.

Ark., Jonesboro—J. F. Morgan & Co., Birmingham, Ala., awarded contract to construct 11 miles of road, asph. conc., aggregating $207,000.

Ark., Little Rock—Philpot & Humphreys, Pine Bluff, award contract to construct 10 mi. improved hwy., Prairie County, from Hazen to a point 10 mi. west at $95,000.

Ark., Mountain Home—Crane Construction Co., Springfield, Mo., awarded contract by Baxter County Commrs., to construct 33 mile highway and brdg., at about $200,000.

Ariz., Clifton—Webster, Webster & Kerby, Clifton, have signed contract and started work on the 32½ miles of Clifton-Springville road through the Apache forest in Greenlee county, Arizona at $236,459. Road will be cut into sides of the mountains and involves large amt of rock excav.

Del., Dover—Suburban Eng. & Contracting Co., Wilmington, awarded contract for completing Shellpot Park Road at $75,561.

Ida., Lewiston—Root & Edwards, Spokane, Wash., awarded contract for improving Dist. No. 11, at $32,025.

Ill., Belleville—Tritt Bros., Belleville, awarded contract for earth grading and bldg. culverts on road from Belleville so. to Hecker and from Belleville to Millscraft, at $35,000 and $16,000 respectively.

Ill., Rockford—Ross P. Beckstrom Co., awarded contract for construction of road to Cherry Valley, the Charles St. road, sect. H. at $85,002; sec. K. $7,130.

Ind., Gary—M. D. Heiny Co., & T. W. Englehart, Gary, awarded contract for 6 separate pieces of street impvt. Aggregate total of contracts $108,496.

Ind., Greensburg—Foulkes Constr. Co., Terre Haute, awarded contract for 2 stretches of concrete road by Bd. County Commrs., Decatur County at $70,497.

Ind., Indianapolis—Sheehan Engineering Co., Indianapolis, awarded contr. to construct Northwestern Avenue conc. road, at $147,200.

Ind., South Bend—H. W. Reeds Sons, Mishawaka, awarded contract for constructing gravel roads, Beehler and Chandler roads in Penn Twp., at $44,795 and $44,650, respectively.

Ky., Whitesburg—Nat Hale, Colson, Ky., awarded contract to construct 1 mile of road along Sandlick Creek, at $30,000.

La., Columbia—C. A. Reese, Columbia, awarded contract by Caldwell Paris Commrs., to build 15 miles of gravel highway, at about $65,000.

La., New Orleans—G. W. Prutzman, Baton Rouge, awarded contract by State Hwy. Comn., and Parish of W. Baton Rouge, to construct 11.67 mile road, hauling and laying of 16,015 cu. yds. washed gravel on W. Baton Rogue Par Link of Jefferson Highway, at $89,200.

La., Thibodaux—Weber & Wild, New Orleans, awarded contract by Lafouche Parish Police Jury for bldg. hard surf. roads in Dist. Nos. 2 and 3, at $82,260 and $50,630, respectively.

Md., Baltimore—Board of Awards let contracts for improving Boone, 21st, 23rd, 20th, Barclay and Oak streets, Homewood and Guilford Aves., to Aner Paving & Contg. Co., Montbello Ave. & Jenkins Lane, at $136,800; Atlantic, Erdman, Dobler and Lake Aves., and Lake St. around Lake Montebelloe to Union Co., 3723 Park Heights Ave., at $2 per sq. yd., total $32,143.

Mass., Boston—West Roxbury Trap Rock Co., awarded contract for filling in Belgrade avenue betw. Anawan avenue and Centre street, and excavating in Centre street on the lines of the proposed widening, at $20,110; Bermudez Company, contract for sheet asph. in East Newton street, at $12,365; Warren Brothers Co., bithulithic pavement in Newbury street—Arlington St. to Fairfield street—at $42,733; M. DeMatteo, contract for bitum. macad. pavement and artificial stone steps in Mascot street—Ballou avenue to Norfolk street—at $4,412; Central Construction Co., for Topeka Pavement in Marble street—Westminster street to Warwick street; Sterling street—Washington to Tremont streets; Warwick street—Hammond to Ruggles streets Westminster street—Hammond to Ruggles streets, at $76,644.

Mass., Lee—James H. Kerr, Rumford, Maine, awarded contract to improve the Jacob's Ladder road. Aggregate amt. to be repaired or rebuilt on this road is abt. 6 miles. $130,000 will be expended for the work.

Mich., Grand Rapids—H. A. Hoxie, awarded contract for constructing 3½ mi. cement road on Knapp highway east from Fairplanes cemetery, at $72,808.

Mich., Detroit—G. B. Scharl, Battle Creek, awarded contract for 7 miles concrete paving and a mile of gravel road at approx. $250,000. This road will connect with conc. pavement from Royal Oak to Rochester and will continue a gravel rd. to Mt. Clemens.

Mich., Lansing—State Hwy. Dept. Lansing, let contract for extending 10,072 miles Sheridan Ave., Class B gravel in Saginaw, to W. S. Hinkley, Flushing, at $102,198; 3,576 mi. Cl. B. gravel rd., Woodbridge and Camden Twps., Hillsdale County, to Bishop & Rowlson, Hillsdale, at $37,797; Cl. B gravel road 15 ft. wide from Saginaw end of Midland Rd., to Midland Constr. Co., Midland, at $174,905; 4,335 mi. Class B conc. rd. in vicinity of village of Farmington, Oakland County, to R. D. Baker & Co., 1454-56 Penobscot Bldg., Detroit, at $175,710.

Mich., Port Huron—Worswick Bros., 410 Hodges Bldg., Detroit, awarded contract Marine city to so. line of county, at $305,000; A. J. Smith Construction Co., Campau Bldg., Detroit, awarded contract for 11 mi. from St. Clair to Muttonville, at $335,000. by St. Clair County Commrs., for paving 11.75 miles conc. rd., 18 ft wide from Co., 2209 First Ave., Birmingham, Ala.,

Miss., Charlestown—Newell Construction awarded contract by Tallahatchie County Commrs., to gravel and surface with bitum. material 21.5 miles of road; 35,000 cu. yds. pit-run gravel; 2,750 screening and 101,000 gals. road oil, at $79.235.

Miss., Cleveland—Heoley Constr. Co., Meridian, Miss., awarded contract for grading and surfacing 27 miles of gravel road at $166,000.

Miss., Tunica—N. A. Dawson, Tunica, awarded contract by Tunica County for constructing 66 miles gravel roads, at $465,000.

Mo., Independence—Kansas Construction Co., Kansas City, awarded contract to pave Holmes Street Road—city limits to Red bridge—4¾ mi.; width 18 ft.; waterbound macadam, at $74,085.

Mo., Kansas City—H. H. Hannankratt, awarded contract for grading Van Brunt Blvd.,—12th to 31st Streets—at $78,000.

Mo., Kansas City—E. F. Clarkson, Kansas City, awarded contract to grade Chestnut St. Trafficway from Lexington to Guinotte Aves., at $52,477.

N. J., Garwood—Eugene W. Chamberlain, Westfield, awarded contract for street impvts., aggregating $116,089.

N. J., Kearney—Maher & McNichols, Passaic Ave., awarded contract for repairing Passaic Ave., at about $15,000.

N. J. Perth Amboy—Liddle & Pfgeiffer, awarded contract for paving Fayette street—State street to State Island sound—with Warrenite, at $31,394.

N. Y., New York City — F. Schneider, Westchester Ave., and Bronx River Rd., awarded contract for bldg., transverse road, regulating, grading, regrading, etc., paving and repaving E. 16th street, Grant, Sherman and Walton avenues; granite blk.

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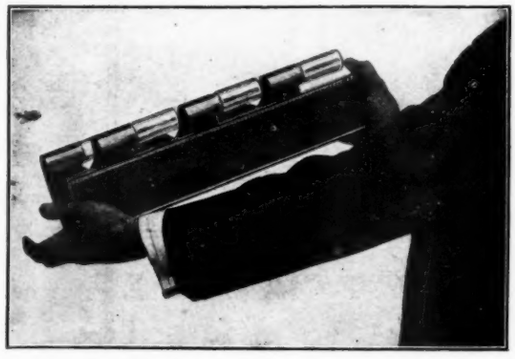

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and sheet asph. on conc., foundation, at $630,327.

N. Y., Syracuse—Following contracts let on State road, Onondaga County; No. 1175 betw. Cicero and Clay, to Guy B. Dickinson, Syracuse at $15,686 also to same contractor, No. 1176, Cemetery Road betw. St. Agnes cemetery and Onondaga County home, at $9,844; No. 1177—4 mi. betw. Liverpool and Three Rivers—to Brayer Bros., Auburn, at $19,741; No. 1178, Marcellus to Marietta—to Henry W. Roberts and Co., Utica, at $29,374; repair contract in Livingston County and one in Otsego County, to R. W. Corporation of Syracuse, at $44,647 and $35,045, respectively.

N. D., Jamestown—Stevens Bros., St. Paul, awarded contract by Stutsman, for grading and installing monolithic concrete culverts on 25.9 miles of road in 2 sections n and s through Cleveland, at $22,878.

Ohio, Columbus—Franklin Asphalt Co., awarded contract for improving Carpenter and Gilbert streets, and will probably be awarded contracts for improving West Broad, East Main and North Fourth streets also. Total amount of five contracts on which this firm was lowest bidder is approx. $365,000.

Ohio, Findlay—Johnson Constr. Co., Chicago, awarded contract for constr. of 2 miles concrete road betw. Findlay and Kenton, at $56,975.

Ohio, Steubenville — Harry M. Bates, awarded contract for paving 5th street at $74,000; two sections are to be paved with vitr. brick and one with creo. wood blocks on cement base with asph. filler.

Ohio, Toledo—Federal Asphalt Paving Co., awarded contract for paving streets in Perrysburg; conc. curb, Trinidad Lake Asphaltic conc. pavement 2-ins. thick on 6-in. conc. foundation, at $56,977.

Ohio, Youngstown—Campbell Bros. City, awarded contract for paving 98 mi. of road in St. Clair twp., at $35,955.

Ohio, Wauseon—Thomas & Burns, Stryker, awarded contract by Comrs. Fulton Co., for paving, grading and draining; also bldg., bridges on 3.64 mi. Sec. "G" Wauseon-Morenci Rd., and .51 mi. Sect. "c-1" Swanton - Metamora Rd., Waterbound macad., at $45,377 and $6,346, respectively; 5 miles Sect. "O" Toledo-Wauseon Rd., waterbound macad., to Zeller and Drum, Swanton, at $92,108.

Okla., Miami—A. R. Young Constr. Co., Little Rock, awarded contract to construct 80,000 yds. bithu. paving at $285,000.

Okla., Oklahoma City—M. A. Swatek Co., Oklahoma City, awarded contract to pave Park Pl., 11th St., Laird Ave., etc., at $77,277.

Ore., Portland — Following contracts awarded by Hwy. Comn.: Porter & Conley, awarded contract for Echo-Morrow road, Umatilla Co., at $180,553; Copenhafen Bros., contract for Jno. Day Hwy. Wheeler Co., at $8,038; Alb. Anderson, Grants Pass, Divide approaches, Lane County, at $12,388; N. W. Trent, McMinnville, Yamhill-Nestucca, at $35,359; Warren Construction Co., The Dalles of Seuferts, 2 mi., Wasco County (stand. bithu.) at $51,872; Oregon Hassam Paving Co., Adams-Athens, Umatilla Co., at $173,046; Clifton, Applegate & Toole, Spokane, Milton-Washington state line, Umatilla Co., 6.2 miles for type "I" at $132,614; type "E" $112,244; type "G" $120,392. Contract for asphalt divided bet. Union Oil Co., and Standard Oil Company.

Pa., Erie—John McCormack & Sons, awarded contract for improving the Watford Plank road, 3 mi. long, leading south of the city and known as Route No .84, at $149,467.

Pa., Philadelphia — Following contracts awarded for improving highways: John F. Nolan, for grading Abington St., Germantown Ave., to Ardleigh St. at $2,556; Ira K. Davis, for grading Belfield Ave., Broad St., to York Rd. at $2,990; Barber Asphalt Co., for asph. paving from 34th to 35th St., at $3,774; Eastern Paving and Construction Co., for asph. paving on Jefferson St., 59th to 60th street, at $6,423; Barber Asphalt Co., for asph. paving on 16th street from Fisher's Lane to Lindley Ave., at $2,708; repairing curbs and footways throughout city, Wm. Bosher, at $30,000; J. Joseph McHugh, for vitr. bl. paving on Pike street—13th to York Rd., at $3,350; R. P. Bennier, vitr. blk. paving on 11th street—Somerville to Clarkson avenue, at $8,094; Eastern Paving & Constr. Co., for asph. repaving on Morris street, 21st street to Point Breeze avenue at $8,723.

Pa., Harrisburg — Following contracts awarded by State Highway Commissioner: Miller Construction Co., Punxsutawney, 13,740 ft. reinf. conc. paving on State Hwy. Route 105, Clinton Co., Chapman Twp., at $108,746; Baldwin & Welcomer, Union City, Pa., State Hwy., R 84, 17,693 ft. reinf. conc. paving, Crawford Co., W. Mead & Woodcock Twps., at $114,759; Miller Constr. Co., Punxsutawney, Pa., State Hwy., R. 97, 29,667 ft. reinf. conc. & hillside vitr. brk. pavement, Elk Co., Ridgway Twp., at $249,176.

Pa., N. Essington—M. C. McCrudden, Franklin Trust Bldg., Philadelphia, Pa., awarded contract for constructing walks, curb., gutter, paving, constructing and connecting water inlets, grading and macadamizing roadway on housing operation of the Westinghouse Elec. & Mfg. Co., at $41,333.

Pa., Pittsburgh — Thomas Cronin Co., awarded contract for construction of link of the McKeesport and Pittsburgh Blvd., through Dravosburg, at $43,692. Contract calls for concrete base and brick block surface.

Pa., Pittsburgh—McLaughlin Contracting Co., awarded contract for rebldg. 12,500 ft. Round Hill road in Forward Twp., at $73,742; W. A. Martin, awarded contract for rebldg. 3,300 ft. Brackenridge road, Harrison Twp., at $47,175.

Tenn., Bristol—Municipal Paving Co., Johnson City, Tenn., award contr. for constructing 17,000 sq. yds. sheet asph. using Trinidad Lake asph. on 5-in. conc. base; necessary curb, butter, storm sewer, grading, etc., at $72,000.

Tenn., Paris—J. T. Calhoun & Co., Nashville, Tenn., awarded contract for grading, draing & chert or gravel surf. roadbed, 24 ft. surface, 16 ft. 7-in. compacted, at $166,-663.

Tenn., Knoxville—Murray Construction Co., Knoxville, awarded contracts to improve streets, at $40,000.

Tex., Abilene—Sanders Bros., Miami, awarded contract by Comrs. Taylor Co., for bldg., 11.61 miles gravel surfaced road—Tye to Trent—including concrete drainage structures, at about $44,000.

Tex., Beaumont — Horton & Horton, Houston, awarded contract by Johnson County Commrs. to construct 11.2 miles asphalt roads from Beaumont to Port Arthur; also 5 miles State Highway No. 3, at $200,000.

Tex., Clarendon—Panhandle Construction Co., Plainview, Texas, awarded contract to pave 4 blocks with concrete and vitr. brick, at $47,000.

Utah, Salt Lake City—Christensen, Jacobs & Gardner, Salt Lake City, awarded contract for bldg. 17,242 ft. road—Centerville to Farmington, 16 ft. wide, involving 34,846 sq. yds. 6-8 in. conc., at $78,786; bldg. 17,232 ft. rd—Clearfield to Sunset—and 15,586 ft. rd—Kaysville to Layton—6-8 in. conc., to Lynch Constr. Co., 5th West and 2nd South Sts., Salt Lake, at $77,542 and $75,756, respectively.

Wash., Ephrata—Mahr Construction Co., Waterville, awarded contract by Grant County for grading and graveling 8 miles Permanent Hyw. 13—Burke to Vantage Ferry on Sunset Hwy. at $26,738.

Wash., Olympia—Contracts as follows awarded by State Highway Board: Tuttle & Duffy, Montesano, awarded contract for hwy. improvement on Olympia Hwy., east from McLeary, covering one mile of gravel and grading, at $17,303; Mitchell Bros., Spokane, awarded contract for grading eight miles Inland Empire Highway—Oakdale to Garfield—at $39,622; H. C. Malott, Seattle, awarded contract for grading, providing brdgs., and 3 miles of Inland Empire Hwy., Uniontown to Idaho line, at $43,533; Northwest Paving Co., Spokane, awarded contract for one mile state road No. 12, Okanogan Co., at $35,948.

Wash., Olympia — Central Construction Co., Spokane, awarded contract for grading and graveling 14 miles of Inland Empire Hwy., Spokane County line north to Springdale, at $153,473.

Wash., Port Orchard—Erickson Construction Co., awarded contract for constructing permanent highway No. 1, C, at $37,800.

Wash., Seattle—C. L. Creelman, awarded contract for constr. of addition to the Stacy street terminal, at $30,989.

Wash., Seattle — Kaiser Paving Co., awarded contract by Bd. Pub. Wks., for paving Leary avenue, at $82,228; 8-in. conc. pavement.

Wash., Seattle—Tacoma Dredging Co., awarded contract for Elliott avenue, Sanitary Fill No. 1 at $149,070; Independent Asphalt Paving Co., contract for filling, grading and paving West Spokane Street, at $161,025.

Wash., Yakima — **Savage & Cornell**, awarded paving contract by City and

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Ozone purifies water by removing Bacteria, Tastes and Odors. It has been used long and successfully in France and other European countries. It is equally well suited for municipal or institutional, large or small plants.

You will have sterile water; 100% protection against epidemics resulting from water-borne diseases by installing an

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It destroys and consumes—literally removes from the water ALL harmful germs and organic impurities—positively—unfailingly—regardless of how much the raw water may be contaminated.

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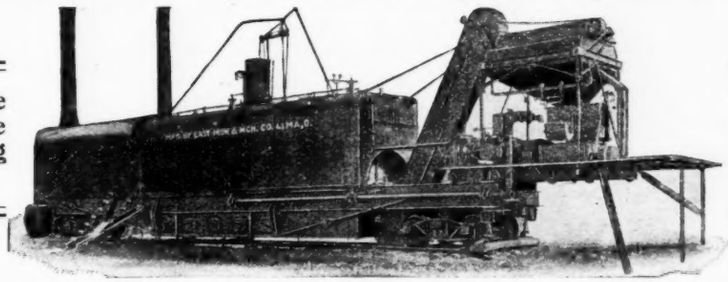

Today: Write for catalog, performance data, and full particulars.

When asphalt must be melted it *does* make a difference how it is melted. If improperly melted the asphalt will burn with disastrous results to the pavement and to the plant itself. With the "Merriman" plant the asphalt can't burn. It provides positive safeguards against burning by the patented steam melting features.

The pavement guarantee rests lightly on the contractor who operates a "Merriman" asphalt plant. It takes much of the hazard out of asphalt work both for the contractor and the municipality.

This steam melting feature produces a perfect quality ot mixture by preventing the burning or coking of the asphalt. This forestalls resurfacing and patching; it insures good results.

These plants are economical as well as safe in operation. Many contractors have secured as high as 3,500 sq. yds. from the No. 1 Railroad Plant, and 2,200 sq. yds. from the No. 2 Railroad Plant in ten hours' production for 2-inch topping.

The "Merriman" steam-heated kettles can be easily and thoroughly cleaned. They are so arranged as to permit efficient agitation. Pipes from kettles to mixers are steam-jacketed and do not become clogged.

East Iron and Machine Company - Lima, Ohio.

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Speed Up Your Grading Job

A cubic yard a minute. That's the record of Baker-Maney Self Loading Scrapers. Seven years of moving dirt has proven them to be the all-round excavator. The large capacity—one cubic yard—the speed of loading—low operating cost and freedom from delays make a combination that means cheap, quick dirt moving.

The "MANEYS" **save 25 to 50 per cent** over two-wheelers. They move dirt cheaper than big excavators on hauls of 200 to 2,000 feet. No skilled labor is required to operate them. A good tractor or a four-up team loads them and one team hauls them. They pull easier than dump wagons. They are the only direct method of moving dirt in quantity.

BAKER Maney Self-Loading Scrapers

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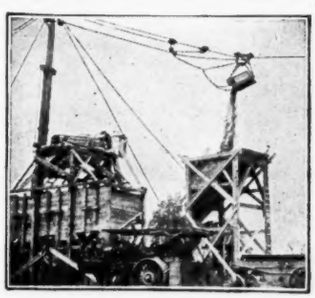
THE BAKER MANUFACTURING CO.
570 Stanford Ave. SPRINGFIELD, ILL.
Ask for Name of Nearest Distributor.

Does this Solve Your Excavating Problem?

Sauerman Dragline Cableway Excavators will dig, elevate, convey material over spans up to 500 feet, and will dump the material at any point. No other type of machine combines digging, lifting, conveying and dumping in one continuous operation.



Road Contractor's Outfit with Sauerman Excavator

These machines are particularly economical and efficient for digging sand and gravel from under water, and have replaced a great many pumps. The ability of the dragline cableway excavator to dig over long spans and to great depth has led to the use of our machines for excavating work which steam shovels or boom dragline excavators could not handle without the help of auxiliary conveying equipment. The development of the dragline cableway excavator has been an important factor in reducing the amount of capital required to install plants for preparing sand and gravel for the market.

Sauerman outfits are economical to operate. One man at the levers of a two-drum hoist controls all the operations of digging, conveying, elevating and dumping. After dumping, the bucket returns to the digging point by gravity.

The experience of our engineers in installing our cableway excavators for hundreds of sand and gravel producers, county road commissioners and contractors, is at your service if you have a gravel deposit to develop or any similar excavating problem. Have you our Catalog?

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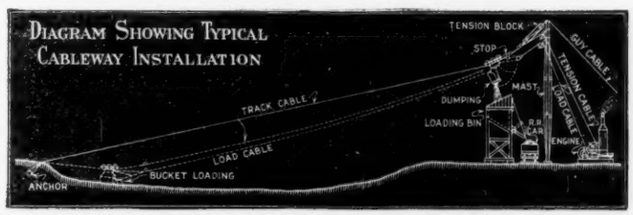
Mnfrs. of Dragline Cableway Excavators, Power Scrapers and Cableway Accessories.



County at $70,169. Contract includes paving sect. so. of Third avenue, within the city limits and its extension as Broadway road into the county. Paving will be Warrenite on concrete base.

W. Va., Hamlin—G. L. Pence, St. Albans, W. Va., awarded contract to construct 6 mile 16-ft. concrete road betw. West Hamlin & Griffithsville, at $2.10 per sq. yd.; J. L. Richmond, Huntington, W. Va., awarded contract for 2 mile 16-ft. concrete on Hamlin-West Hamlin Road at 2.15 per sq. yd.

W. Va., Middlebourne—Allen & Horner, Clarksburg, W. Va., awarded contract by Tyler Co., Commrs., to construct 2½ miles of road—Middlebourne toward Shirley at $72,500; asph. stone base.

W. Va., Ripley—Cisler & Morse, Marietta, Ohio, awarded contract by Jackson Co., Commrs., to construct 2 miles 14-ft. concrete road, at $57,500.

Wis., Superior—Riches & Sons, awarded contract for paving Tower avenue, 28th street for dist. of 30 blocks, at $81,610.

SEWERAGE AND SEWAGE TREATMENT.

Ark., Forrest City—J. McCoppin, Little Rock, Ark., awarded contract to construct 7 mile storm sewers and concrete streets, at $100,000.

Cal., Santa Barbara—A. A. Lemmon, awarded contract for constructing sewer in Rancheria street, at $6,083.

Cal., San Luis Obispo—Mike Chutuk, 1506 Pleasant street, Los Angeles, awarded contract for constr. of cement pipe storm drain in Marsh street and other streets at $16,809.

Fla., Jacksonville—City rescinded contract let to Flynn & Co., for bldg. sewers, and relet same to Bryan & Co., Phelps street, at $52,394.

Ga., Macon—Dixie Engineering Co., Macon, awarded contract to construct sanitary sewer in So. Macon, 3 miles long, at $33,449.

Ga., Macon—Tom Lowe, lowest bidder at $32,860 for sewer work in South Macon. Sewer Comm. will recommend that he be awarded the contract.

Idaho, Moscow—Washington Brick & Lime Co., Spokane, awarded contract for installation of vitr. clay salt-grazed pipe, at approx. $14,000 for the pipe.

Ill., Chicago—Contracts for drains in various streets awarded as follows: Mike Di Vito in section of So. Albany avenue, system of streets—N. California and N. Fairfield avenue; also Parker, Schubert and Wright avenues; Nick Santucci, N. N. Lorel avenue, N. Parkside avenue, Patomac avenue and West Walton street.

Ind., Terre Haute—Following contracts let for sewer construction: P. O'Leary & Sons, sewer on Sycamore street—15th to 17th streets, N. 16th—Sycamore to Liberty Ave., and N. 12th—Grand to Florida aveneu; W. H. Harris, Sycamore—24th to 25th S. 13th—one-half from Ohio to Walnut and S. 16th—Crawford to Farrington street. These contracts cover abt. one mile of sewer work.

Ia., Davenport—J. Bredow, 822 Gaines St., awarded contract for bldg. 8,745 ft. sewer in Monroe St.—Spring to Judson streets, at $12,655.

Iowa, Davenport — Hydraulic Concrete Constr. Co., awarded contract for sewer, Monroe and Johnsons streets and in Rose & Martinzahn's Addn.

Iowa, Logan—E. A. Wickham & Co., Council Bluff, Iowa, awarded contr. for constructing storm sewers in connection with paving, grading, etc., etc., on 55 blocks, at $210,000.

Iowa, Tama—Dearborn Constr. Co., Waterloo Savings Bldg., Waterloo, contr. for 600 ft. 15-in. pipe at $1.15 per ft.; 10,900 ft. 12-in. at $0.97 per ft. and 185 ft. 10-in. at $0.89 per ft.

Md., Baltimore—Senator Vare, awarded contract for constr. of Pollock St. sewer betw. 26th and 30th streets, at $175,000; Emilio Pascuzzi, awarded contract for constr. of Rock run sewer in Godfrey avenue—10th to Broad street, at $75,000; Whiting-Turner & Co., awarded contract for Pratt St. sewer at $45,000. Contracts for 10 branch sewers aggregating $50,000 were also awarded by Director Datesman of the Public Works Dept.

Mass., Boston—A. Cefalo, awarded contract for sewerage works in Levant and Tebroc streets, at $3,016; Daddario & Booth, contract for sewerage wks. in Cameron and Tovar streets, Dorchester, at $2,133; Antony Cefalo, contr. for sewerage wks. in Bayswater street, betw. Austin avenue and Waupello road, East Boston, at $2,144; Anthony Baruffaldi, contr. for sewerage wks. in Deer street, Dorchester, at $2,977.

Mass., Boston—J. W. O'Connell, awarded contract for bldg. sewerage works in Portland. Traverse and Merrimac streets, at $8,995.

Mich., Detroit—Following contracts for bldg., sewers awarded by Bd. Public Works: 2859 ft. Erwin Ave., Pub. sewer in Burns, Peter, Hunt and Erwin aves.—Harper to Edgewood aves.—to R. D. Baker, 1454 Penobscot Bldg., at $41,711; 7,956 ft. Dexter Blvd., Pub. sewer—Joy Rd. to Davidson Ave.—to W. Porath, 1410 W. Grand Blvd., at $136,539.

Minn., Keewatin—E. W. Coons Constr. Co., Hibbing, awarded contract for sewer ext., and disp. plant, at $59,184.

Miss., Pascagoula—J. C. Mishler, 105 Spruce Street, Chattanooga, Tenn., awarded contract for bldg. sewerage system, at abt. $64,415.

Mo., Kansas City—McCarthy Construction Co., awarded contract by Board of Public Works, for bldg. comb. storm and sanitary conc. sewer in district bounded by 40th, 43rd, Indiana and Agnes streets, at $36,000.

Mont., Great Falls—Mr. Fred Sauer, Butte, Mont., awarded contract for furnishing labor, tools and materials and appliances for constr. of storm sewer on South Avenue south, with branches on Third and 7th streets, at $206,449.

N. Y., Albany—Murphy Bros., 262 Bay 43rd St., Brooklyn, N. Y., awarded contract for sewage disposal plant, Brooklyn State Hospital, Creedmoor division, Brooklyn, at $22,483.

N. D., Lakota—Haggert Construction Co., Fargo, awarded contract for construction of sewer at $40,582.

Ohio, Cleveland—Gaughan Constr. Co., to lay intercepting sewer at E. 24th street betw. St. Clair Ave. and Superior Ave., at $17,000.

Ohio, Warren—Harry Poff, awarded contract for construction of sewer, at $11,345.

Okla., Oklahoma City—Municipal Excavator Co., awarded contract for constructing sanitary sewer to serve lots 9, 12 and 13 in Howes Capitol Addition, at $8,000.

Ore., Astoria—John Mattson, Astoria, awarded contract for sewer and drainage work (No. 10A vitr. pipe) at $13,463.75.

Pa., Easton—Korp & Korp, Phillipsburg, awarded contract No. 3 at $28,551, which is in addition to Contract No. 5 which they were awarded a few days ago and which comprises the erection of the Phillipsburg sewer.

S. D., Madison—Gudney & Murphy, Minneapolis, awarded contract for constr. of storm and sanitary sewers, at $41,584.

Texas, Dallas—F. A. Eldridge, Dallas, awarded contract by City for bldg. sewer in Jefferson Avenue, 10th to Marsalis streets, at $12,221.

Wash., Coulee City—J. C. Broad, Spokane, awarded contract by Council for constr. of city sewer at $32,695.

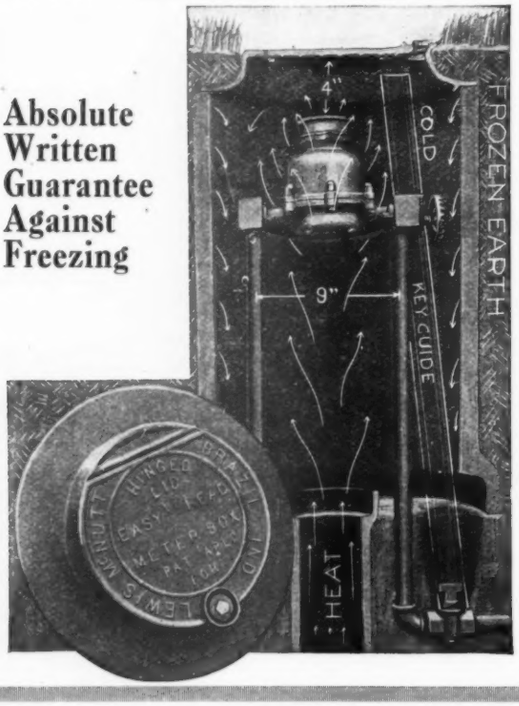
Wis., Green Bay—H. O. Schafer, local, awarded contract for sewer constr., in 5 streets.

WATER SUPPLY AND PURIFICATION

Cal., Los Angeles—Bent Bros., 825 Central Bldg., Los Angeles, awarded contract for constructing conc. masonry dam, outlet tunnel, spillway and roadway at Devils Gate in the Arroyo Control District, at $169,907.

Ct., Hartford—Foundation Co., New York City, lowest bidder for constr. of 8 cov-

Absolute Written Guarantee Against Freezing



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SAVE TIME, TROUBLE AND EXPENSE

There is no guesswork or verbal promise about the freeze-proof features of **McNutt Meter Settings.** Thorough testing in actual service enables us to give an absolute *written* guarantee with every setting.

McNutt Meter Equipment prevents freezing, saves time and trouble in reading and setting, and eliminates 75 per cent of time in taking out and replacing meters. The McNutt Easy-to-Read 15-inch box, with hinged lid, guarantees protection and eliminates the old-style 18- and 20-inch boxes. The Easy-to-Install Yoke places risers 9-inch centers, pipes closest possible and farthest from frost line.

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Box M 1. **BRAZIL, IND.**

STEWART SEWER CLEANING MACHINE

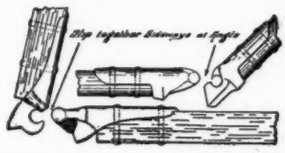
Water Cleaning System if you wish it, or Drag Bucket type.

Also have TURBINE SEWER CLEANING MACHINE at Low Price.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also Rods with wheels for conduit work.



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No Deep Shoulder Cut for Couplings—Rods retain full size and strength

Investigate our JUMBO ROD

W. H. STEWART

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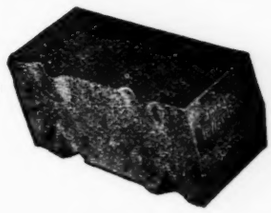
CANADA FACTORY, WALKERVILLE, ONT.
THEREFORE NO DUTY FOR PURCHASER TO PAY
PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

Springfield Wire-Cut Lug



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Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

POWER TAMPING

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—permanent backfilling
—lower tamping costs
—faster and regular work

PAWLING & HARNISCHFEGER CO.
MILWAUKEE WISCONSIN

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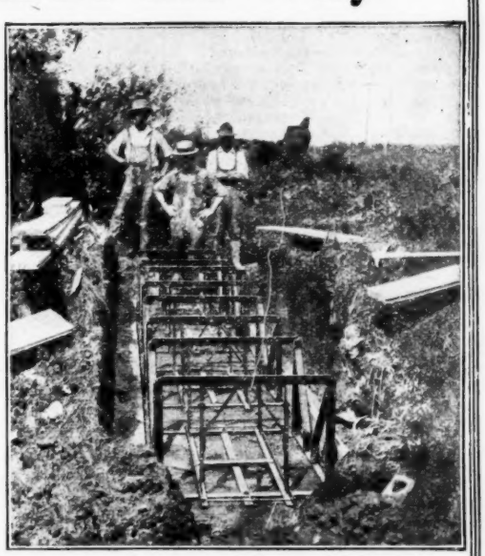
THE P. & H. POWER TRACTION TAMPER

Here's the Way

To Build Concrete Culverts



You save all the *time* and *labor* required in sawing, fitting and nailing together wooden falsework only to *tear it out* again.

A Continuous Iron Frame Work—rigid and absolutely true to line. No sagging from dampness.

The One-Man Collapsible Culvert Form

Write for Illustrated Catalog

Collapsed and removed from the completed culvert in five minutes time.

THE STORMS MFG. CO.
Crawfordsville, Ind.

ere dconcrete masonry filters, substructures for 2 regular houses and an office and labatory bldg., an aerator, a gate chamber and piping to be built near reservoir No. 1 in W. Hartford, at $627,600.

Conn., Wethersfield—C. H. Slocomb, 25 Victoria Rd., Hartford, awarded contract for bldg. 4 mi. wood pipe water mains, at $14,000. Wk. involves 22,000 ft. 4-8 in. wood pipe.

Fla., Manatee—G. A. Miller, Tampa, Fla., awarded contract by Manatee Fruit Co., to construct 50,000-gal. tank and tower to supply sprinkler fire-prevention system.

Ill., Chicago—Following contracts let for water supply pipes; Simon R. for laying pipes in sections of following streets: Bennett Ave., No. California Ave., West 11th street, in system of streets—N. Austin, Milwaukee Ardmore, No. Mason and Elston Aves.; De Vito & Till, South Bishop St. and system of streets—So. Knox, So. Kilpatrick, So. Keating and South Cicero Aves.; Scully Bros., Crandon Ave.; M. J. Bohan, Parnell Ave. and in Wentworth Ave.; Christ Anderson, in Paxton Avenue.

Mass., Boston—Jas. Barletta, awarded contract for laying and relaying water pipes in Mozart and other streets in Jamaica Plain, at $9,695; V. Grande, 59 Hull street, awarded contr. for laying high pressure pipe line in Atlantic Ave., involving 1,935 ft. 8-20 in. c. i. pipe, 15 cu. yds. conc. 2,600 cu. yds. earth and 20 cu. yds. rock excav., etc., at $12,055; C. M. Callahan, 23 S. Fairview street, awarded contr. for laying pipe line in Causeway street, at $15,350. Wk. includes 19 ft. 8-16 in. gates.

Mass., Boston—Carmin Russo, awarded contract for laying and relaying water pipes in Baker, Catherine and Florence streets, Lamartine court, Robin and Swallow streets, Whipple Avenue, West Roxbury; Middleton Street, Dorchester; Bellvita road, Brighton, and Glenwood avenue, Hyde Park; also establishing gates in Baker and LaGrange streets, West Roxbury, at $4,160; also contract for laying and relaying water pipes in Dudley street betw. Nonquit street and Columbia road, at $1,970.

Miss., Oxford—Carloss Well & Supply Co., Memphis, Tenn., awarded contract to construct and equip 12-in. well, including pump, etc., at $3,200.

Mo., Carrollton—E. L. Harper, Kansas City, awarded contract for bldg. filtration plant. Work involves bldg. two 70x90 ft. settling basins, 9 ft. deep with 380,000-gal. capy. each; also two 40x40 ft. smaller basins with 45,000-gal. capy. each and 2 clear water wells.

N. D., Lakota—Schruth & Jackson, Minneapolis, awarded contract for constr. of water system, at $80,487.

N. D., Minot—Bartelson & Ness, City, awarded contract for constr. of a 3,000,000-gal. reinf. conc. supply reservoir at $54,577; contract for excavation let to Minot Constr. Co., at $4,295. Frederick Bass, Consulting Engr., Minneapolis. E. J. Thomas, City Engr.

Okla., Poteau—Merkle Machinery Co., Kansas City, awarded contract to construct water works system, at $89,798.

Okla., Tulsa—J. T. Lantry, Tulsa, awarded contract to construct gravity intake system from Ark.. River, at $15,800.

S. D., Mitchell—Contracts let to following for water works system: National Cast Iron Pipe Co., Birmingham, Ala., contr. for piping, at $13,930; Brown & Kings, Mitchell, S. D., for laying, at $11,757 and for bldg., at $15,182; Merkle Machinery Co., Kans. City, Mo., for machinery, at $31,500; Harris Air Pump Co., Chicago, for well pumps, at $13,339; R. Jamison, local, for wells, at $6,600; Merkle Machinery Co., for stock at $2,200. Engrs. Burns & McDonnell, Kans. City, Mo.

Tenn., Oxford—Well & Supply Co., Memphis, Tenn., awarded contract to construct and equip 12-in. water well, with 9-in. working valve; 130 ft. deep; daily cap. 175,000 gals.

Wis., Milwaukee—F. H. Nakielski Co., Humboldt Ave., awarded contract for water pipe tunnel under Milwaukee river from ft. of W. Water street Reed street.

BRIDGES AND BUILDINGS

Cal., Visalia—Concrete Pipe & Construction Co., Porterville, awarded contract at $10 per cu. yd. for Cl. A and $9.75 per cu yd. for Cl. B conc. for constr. of 4 conc. brdgs., 3 conc. culverts and 8 wings for culverts on Woodville-Tipton county hwy.

Colo., Denver—F. E. Dreher, awarded contract to construct 2 conc. brdgs. over Cherry Creek at total cost of $47,603. Bridges will be built at West Colfax Ave., and at Logan street.

Colo., Denver—M. J. Kenney, awarded contract for bldg. bridge over Cnerry creek at Logan street, at $16,230; also contract for brdg. over Cherry creek at Colfax street, at $20,890.

Ga., Dalton—Luten Bridge Co., York, Pa., awarded contract by Whitfield Co. Commrs., to construct two 50-ft. arch spans with 12-ft. roadway, reinf. conc. bridges, at $7,950.

Ga., Oglethorpe—Austin Bros. Bridge Co., 156 Greenwood Ave., Atlanta, Ga., awarded contract for bldg. steel and rein. conc. bridge over Flint River betw. here and Montezuma, at $45,040; Contract No. 2 and No. 3 to Nicholos Contracting Co., Trust Co. of Georgia Bldg., Atlanta, at $81,464 and $27,558 respectively.

Ill., Ottawa—Ollendorf Constr. Co., Paletine, awarded contract for erection of 250-ft. arch bridge at Glenn Park, at $23,450.

Ill., Springfield—Following contracts for bridge construction awarded by Dept of Pub. Works and Buildings: M. C. Robinson, Girard, Ill., award. contract for Cable bridge in North Otter Twp., Macoupin Co., at $1,990; Hladd & Dresch, Edwardsville, awarded constract for Hauck and Hilliard bridges in Bunker Hill Twp., Macoupin County, at $2,674; M. C. Robinson, Girard, Ill., awarded contract for Kime bridge, Nilwood Twp., Macoupin Co. at $1,247; Herrick Construction Co., Carlinville, Ill., awarded contr. for 8 bridges and Otis Kirt-Twp., Macoupin County, at $1,038; Berenz & Son, Bloomington, Ill., awarded contract for Bean bridge, Bloomington Twp., McLean Co., at $3,493.

Ill., Toledo—B. F. Clark & Son, 5052 Cates Ave., St. Louis, Mo., award. contract for constructing one rein. conc. bridge in Union Twp., known as Decker bridge, at $2,100.

Ind., Danville—Robert H. King, Danville, awarded contract for constr. of Stanley bridge near Plainfield, at $13,875; D. Fatout, awarded contr. for 8 bridge and Otis Kirtley, contr. for one bridge.

Ind. Terre Haute—Following bridge contracts awarded by Vigo County Commissioners: Loyd & Weeks Co., Miller bridge at $3,000; Welsh bridge at $2,472; Bresee Mfg. Co., Jackson Hill bridge at $4,140! David Jenkins, Black bridge at $2,748.

Ia., Atlantic—Wickham Bridge & Pipe Co., Council Bluffs, awarded contract for bldg. 20 conc. box culverts, 2 I-beam brdgs., etc., at $47,840.

Ia., Fort Dodge—Koss Constr. Co., 5th & Interurban Ry tracks, Des Moines, awarded contract for matl. mach. and labor for constr. of reinf. conc. brdg. across Des Moines river betw. N. First street and 2nd St. N.W., at $49,999.

Ia., Ft. Dodge—Webster County Bd. of Supvrs. let following contracts for 20 conc. bridges at total of $28,878: A. Olson Construction Co., W. T. Baxter of Waterloo; Carl Johnson of Humboldt. Nebraska Bridge & Supply Co., contract for lumber & piling; Fort Dodge Iron Mills Co., contract for culvert pipe.

Ia. Kimballton—Jensen Construction Co. awarded contract for 57 cement bridges and culverts, at $24,000.

Ia., Mason City—Henkel & Brown, awarded contract for constr. of 8 brdgs. in county at $20,900.

Ia., Tipton—Following contract awarded for bridge construction: F. J. Smith, Tipton, 30 box culverts, at $12,684; Alfred Vinall, Davenport, Ia., 15 box culverts and one I-beam span, at $8,257; C. M. Neal, Lyons Ia., 22 box culverts, 3 I-beam spans, at $13,900; S. R. Johnston, Tipton, 27 box culverts, one I-beam span at $9,930 and Anderson & Son, Maquoketa, 3 pony trusses, one pair of abutments, at $20,600.

Ia., Waterloo—Fifield Constr. Co., awarded contract for bldg. rein. con. bridge over Cedar River on Souci-Whitney Rd., at $73,-885.

Mich., Lansing—Following contracts awarded by State Hwy. Dept., for building 5 trunk line bridges: Ira J. Lyons, St. Joseph, Mich., brdg. 161 over Beaver Creek to Adrian, at $8,500; Samuel Mills, Escanaba, Mich., brdg. 214, over Days River in Brampton Twp., Delta Co., at $4,258; Geo. W. Clark, Muskegon, Mich., brdg. 110 over White River, Ferry Twp., Oceana Co., at $6,568; Bernard Banhagel Iona, Mich., brdg. 204, over Grand River so. west of Iona, at $1,876: Gus Anderson, Marquette, Mich., brdg. 257, over Little Ocequeoc River near Rogers, at $3,600.

Minn., Carlton—Wm. S. Hewitt, 530 Met. Bank Bldg., Minneapolis, awarded contract for Bridge No. 3006, at $2,193.

Minn., Oklee—Minneapolis Bridge Co., 1035 Metropolitan Life Bldg., Minneapolis, awarded contract for new concrete bridge at $7,000.

Minn., Wabasha—Independent Bridge Co., 1101 Metropolitan Life Bldg., Minneapolis, awarded contract by Wabasha County for bridge 3015 over Zumbro river at $6,747; bridge No. 3016 at $2,375 and No. 3017 at $4,078.

Minn., Warren—Abel Ness, Crookston, Minn., awarded contract at $6,250 for 20x50 steel and conc. bridge over Snake River.

Miss., Charleston—Gould Contracting Co., Nashville, Tenn., award contr. for constr. of steel spans and substructure of steel r. r. brdg. across the Tallahatchie River, at $23,000.

Mo., Kansas City—A. S. Hecker Company, Cleveland, awarded contract for construction of 23rd St. viaduct. Bid of company is as follows: bldg. entire viaduct & paving with wood blk., $731,000; or, paving with either brick or bithu. paving, $716,000, including the $50,000 profit fee asked on the "cost plus" basis.

N. D., Devils Lake—J. A. Jardine, Fargo, N. D., awarded contract by Ramsey County for conc. culverts on 3 mi. State Aid Rd., 6 mi. east of here; for monolithic conc. culverts on Fed. Aid Proj. 19, at $3,885; also constr. for monolithic conc. culverts on Proj. 18, at $1,627.

N. D., Devils Lake—T. & L. D. Libby, 354 Temple Court, awarded contract for concrete overhead bridge, at $20,000.

N. D., Hillsboro—M. S. Anderson, Hillsboro, awarded contract for constr. and material for new bridges and repairs of old bridges during 1919.

N. D., Williston—Independent Bridge Co., Minneapolis, awarded contract for monolithic concrete culverts and 3 concrete bridges on 30.5 miles of Fed. Aid Project No. 3, at $26,249; Schultz Bros., Bowbells, N. D., also awarded contract for grading and install. corc. metal culverts on 30.5 miles (in 4 sections) of Fed. Aid Project No. 3, at $61,047.

N. J., Trenton—Celestano & Pinto, 500 Bridge St., Trenton, awarded contract for constructing steel and conc. bridge across Assampink Creek at $10,340.

N. J., Gloucester—E. P. Henry & Son, 98 Green St., Woodbury, awarded contr. for bldg. conc. bridges over Little and Big Birch creeks, at $33,561.

Okla., Grandfield—Tillman & Wichita Counties Bridge County awarded contract to Austin Bros. Bridge Co., Dallas, to construct pile and lumber bridge across Red River, at $60,000.

Okla., Guymon—Missouri Valley Bridge & Iron Co., Leavenworth, Kans., awarded contract by Texas County Commrs. to construct 3 bridges, at $13,349.

Pa., Connelsville—A. DePolo, Connelsville, awarded contract by City to build conc. arch bridge over Connell Run under East Park viaduct, at $13,354.

Pa., Harrisburg—H. Denburger Contracting Co., Bethlehem, Pa., awarded contract for furnishing labor and materials and constructing bridge over the North Branch of the Susquehanna River at Falls, Pa., at $185,554.

Pa., Mayfield—Holt Lumber Co., Carbondale, Pa., awarded contract for constructing conc. girder bridge at $16,200.

Pa., Philadelphia—King-Brown Contracting Co., awarded contract for constructing 68 piers and foundations for the section of the Frankford L. Line south from Allowhill to Arch street where road will connect with Market Street subway at $29,800.

S. C., Gaffney—M. M. Elkins, local, awarded contr. by Southern Ry. Co., for reinf. conc. bridge at Montgomery street crossing, at $60,000.

S. C., Marion—Chitwood & Palmer, Columbia, S. C., awarded contract by Marion Co. Commrs., to construct bridge across Little Pee Dee River at Galivant's Ferry, several bridges through swamp and 3½ miles of road, at $40,668.

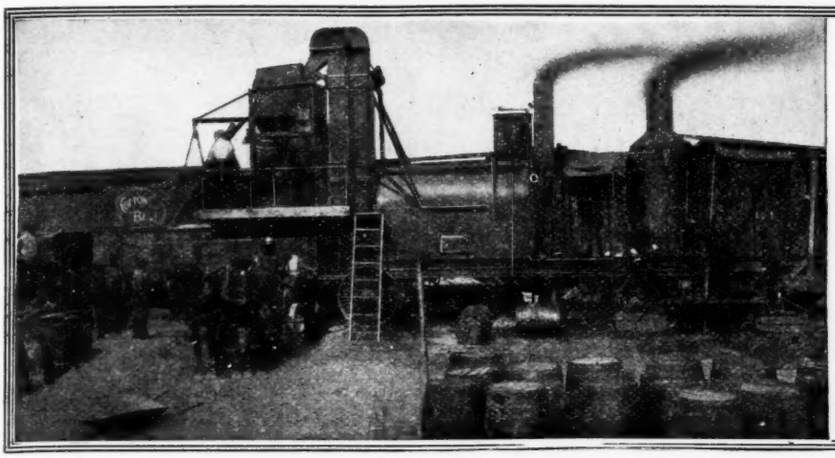
Tenn., Embreeville—Southern Bridge Co., Birmingham, Ala., awarded contr. by Washington County Brdg. Comm., to construct bridge across Nolachuchy River, at $20,000.

Tenn., Knoxville—Monroe C. Monday, local, awarded contract for bldg. reinf.-conc. viaduct. The amt. of his bid with sand as a filler is $219,312.50; with gravel, $224,-312.50. Exact amt. of contract will depend on proportion of these materials which is decided upon by the engineer.

Utah, Salt Lake City—Wattis-Samuels Co., awarded contract for constr. of 7 conc. bridges betw. Midvale and a point 4 miles south, at $10,569.

W. Va., Meadville—Johnson & Dotson, Middlebourne, W. Va., awarded contract by Tyler County to construct 55-ft. span bridge across Sugar Creek. at $2,750; also contract to construct 60-ft. span bridge across Indian Crk., at $3,500.

W. Va., Buckhannon—Corns-Thomas En-



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gineering Co., Huntington, W. Va., awarded contract by Upshur Co. Commrs., to construct reinf. conc. arch bridge over Buckhannon River, at $7,991.

Wis., Beloit—Klug & Smith, 40 Mack Bldg., Milwaukee, awarded contract to construct bridge, at $67,000.

Wis., Janesville—Wausau Iron Works, Wausau, Wis., awarded contract for bldg. new bridge to span Rock River at Jackson street, at $78,400 for the structure proper and $3,000 additional for street railway work.

DRAINAGE AND IRRIGATION

Cal., Olinda—W. A. Kramer, San Francisco, Cal., awarded contract for constructing Messelbeck dam and digging Hoover tunnel at approx. $315,000.

Idaho, Boise—Secretary of the Interior has authorized Reclamation Serivce to award contracts for constr. of Notus Canal and Feeder No. 2 in connection with Boise Irrigation project; Idaho Construction Co., Boise, contract for portion of Notus canal at $19,426; S. C. Comerford, R. F. D. No. 1, Boise, certain divisions of Feeder Canal No. 2 and portions of Notus canal—Total contract price $39,130.

Ind., Anderson—Fred Haas, Pendleton, Ind., awarded contract for bldg. Nicholson drain, with tile and vitr. tile at $1,705.

Ind., Anderson—Summitville Drain Tile Co., Summitville, Ind., awarded contr., for constructing Clem Drain, at $4,173.

Ind., Liberty—Arch H. Nutty, Connersville, Ind., awarded contract for constructing public drain in Union and Franklin Counties, at $8,100.

Ia., Storm Lake—M. C. Rasmussen, Newell, Ia., awarded contract for filling open ditch of Buena Co. Lateral of Joint Drainage District 16-30-92 at $3,238.

Minn., Mankato—North Star Construction Co., City, awarded contract for constructing judicial ditch No. 24 Blue Earth, Martin & Faribault Counties at $66,924.

Minn., Marshall—Theo. Jensen, Clayton, awarded contract for constructing Judicial Ditch No. 20, at $149,300.

Minn., Marshall—Marshall Conc. Tile Co., City, awarded contract for constructing County Ditch 43, furnishing and laying 62,081 ft. to 30-in. tile, at $34,974.

Minn., Waseca—Minnesota Constr. Co., Minneapolis, awarded contract for constructing county ditches Nos. 42 and 45 at $11,974 and $10,097, respectively; Love & Hewitt, Le Roy, Ind., Jno. Erickson, Waseca, awarded contracts for constructing Judicial Ditch No. 5 in Waseca and Steele Counties, $17,755 and $645, respectively.

N. J. Jersey City—J. D. Manahan, Red Bank, awarded contract by Mosquito Extermination Comn., Hudson Co., for 100,000 ft. drainage ditches on salt marsh meadows—Bergen county line to Kill von Kull extending along either side of Hackensack River—at $0.75 per lin. ft.

N. Y., Rochester—Empire Engineering Co., Ins. No. 6 Church Street, New York City, awarded contract for completing canal from Kings Bend to Lehigh Valley R. R. crossing, involving 61,000 cu. yds. excav., and 20,000 yds. of embankment.

S. C., Orangeburg—John J. Quinn Co., Miami, Fla., awarded contract by Co. Castle Draing. Dist., for drainage constr. at 12c per cu. yd. for main canal (dredge wk.) and 30c per cu. yd. for laterals (hand wk.)—total $141,660.

S. D., Madison—New Ulm Drainage and Constr. Co., City, awarded contr. for furnishing material and completing constr. of Lake County Ditch No. 15, at $55,000.

PROSPECTIVE WORK

ROADS AND STREETS

Ark., Fort Smith—City Engr. Evans completing plans and specfs. for paving impvt. district—17 blocks of street in heart of business district. County will add to this the paving of No. Towsen avenue from terminus to junction with Grand and along the latter avenue to present paving on that street.

Ark., Hot Springs—Ordinances being prepared for forming several paving districts; one of 8 blocks, one of 25 blocks, one 12 blocks and one of 20 blocks. Cleveland Smith, City Engr.

Ark., Little Rock—State Hwy. Dept. has completed prelim. plans and est. of cost of improved hwy., Logan Co.,—Paris to Roseville; abt. 7.47 miles. Standard 22-ft. roadbed will be used with macadam surf. treatment 12 ft. wide and 6 ins. thick. Est. cost $79,860, or $10,690 a mile, which includes conc. culverts, grading, steel bridges, etc., etc.

Ark., Monticello—Bartholomew Road Improvement Dist., Drew County, will construct 85 miles hard-surfaced roads. Will open bids abt. June. Pritchett, Hight and H. R. Carter, Engrs.

Ark., Paragould—Survey now being made by County of 22 miles hard-surface rd., east of town and 42 miles west of town, which will be constructed this summer. Guy Adams, City Engr.

Ark., Sheridan—State Hwy. Comn., Little Rock, Ark., plans to construct 24.19 miles of highway—Leola to Poyne—Grant County; 22-ft. embankment $176,576.

Ariz., Clifton—$200,000 bonds voted by Greenlee County for improving county highways. $50,000 available from state funds June 1st. It is expected this amt. will be doubled by fed. aid. State desires to widen portion of Clinton-Solomonville hwy., and is interested in the Ward's canyon rd., Clinton-Franklin road and Morenci-Metcalf roads in order named.

Ariz., Phoenix—State of Utah, from its own funds and federal sources, will have $8,000,000 to spend on roads in next two years, part of which will be used to build and maintain a hwy. in the Arizona state line.

Ariz., Phoenix—County Hwy. Comn. has recommended bldg. 272½ miles paved highway, Maricopa Hwy., Est. cost $4,500,000. Abt. $500,000 can be obtained from federal and state aid funds. Comn. recommends that proposition to issue bonds ($4,000,000) for hwy. constr. be submitted to voters.

Ariz., Tucson—Work will start on Mt. Lemmon road as soon as governor signs bill making it possible for Pima Co. officials to sign contract with U. S. forest service. There will be 7.23 mi. of rd. with 10 per cent grade which can be built within total amt. available—$50,000.

Cal., San Francisco — City Engr. O'Shaughnessey has suggested to Board of Supvrs., improvements for the coming year totaling estimated expendts. of $4,581,020. Among the most important of these impvts. are the leveling of Rincon Hill, $3,500,000; widening of the Bernal cut, $400,000, etc.

California, Madera County—Project being considered to build conc, rd., from Chochilla to connect with Santa Rita bridge on line of proposed Pachico pass line of State hwy. Est. cost $225,000. Sonoma County citizens in favor of constructing a 50-mile boulevard through Sonoma County to Bodega Bay on Pacific shore. This is a million dollar impvt. Redding City trustees have instructed City Mgr. Rolison to draw plans and specfs. for paving over a mile of streets. The asphalting of Market street is to be extended north and south to connections with State Hwy. Butte, Yuba, Tehama and Shasta streets are to be paved betw. Market and Pine. All streets around Court House are also included. Lodi—Supervisor J. W. Syuckenbruck reports that Bd. of Supvrs. will set aside $8,000 for grading and paving streets of Woodbridge. Wk. will begin soon. Rio Vista—Plans being formulated for bldg. State Hwy. bet. Suisun and this city—abt. 24 miles. Est. cost abt. $350,000.

Fla., Jacksonville—City will expend $125,000 to improve Main, Hogan, Washington and other streets. John T. Alsop, Jr., Pres. City Council.

Fla., West Palm Beach—City contemplates expendt. of $60.000 for street and sewer work. Increased activity last four weeks indicates possible considerable increase. H. C. Fugate, City Engr.

Idaho, Boise City—City will pave on 11th and 12th streets betw. Bannock and State, at $13,142 and on 11th and 12th streets across R. R. at $12,000. C. C. Stevenson, City Engr.

Idaho, Grangeville—U. S. Bureau Pub. Rds., Portland, Ore., plans to grade 28 miles Kootenai Cabinet Rd., betw. Hope and Pack River, Bonner County. Abt. $25.000. L. I. Hewes. Broadway-Yamhill Bldg., Portland, Dist. Engr.

Ida., Sand Point—Highway 5 miles long will be built this summer betw. Addie and Copeland in the Pend d'Oreille National Forest. Est. cost $10,000.

Ill., Chicago—City's paving bill will average about $8,000,000 for the year. M. J. Faherty, Pres. of Board, hopes to get all possible work under way soon. Included in proposed improvements are following: Lawrence Ave. Milwaukee to Austin avenues, creosote, $68,000; Leavitt street—Wabansia to Milwaukee, macadam, $4,200; Longwood drive, 114th Pl. to 119th St., Asph. $34,000; Morgan street—75th to 76th, asph. $9,000; Otto—Robey to Ravenwood avenue, asph., $15,500; So. Chicago avenue—87th to 89th, brick, $29,000; So. Park Ave.,—95th to 104th street, macadam, $79,000; W. 25th Pl.,—Halsted to Morgan, asph., $12,300; Wabash Ave.—north of 108th, macadam, $4,000; Windsor Ave.,—Milwaukee to LaVergne avenue, asph., $12,600; 18th street—Central Pk. avenue & alleys, brk., $12,000; Lafayette avenue system,—65th to 69th street, asph. $47,000; Claremont, Devon, Granville street system, macadam, $64,000; Cornelia, Kildare and Lowell avenues, st. system, asph. $92,000.

Chicago—County Board, Cook County, Illinois, have approved plans for extensive road building: Sections approved are as follows—2 sects. of Lincoln hwy., one extend'g ½ mi. no. of Mattison, abt. 16,163 ft. Est. cost $82,253; one at intersect. of Lincoln hwy. with Dixie hwy., South Chicago Heights, extend'g. east 31,859 ft. Est. cost $175,596; 2 sects. of Chicago-Waukegan-Milwaukee rd, extend'g. no. from Niles 10,240 ft., $65,686; the other extend'g. no. from Morton for 15,000 ft., $106,371. S. E. Bradt, Supt. of Div. of Hwys.; Alfred Older, Chf. Engr., Springfield, Ill.

Ill., Granite City—City considering following improvement work during 1919: B Street paving Dist.—14,100 sq. yds. 2-course conc.; 22nd St., Pav'g. Dist.—14,300 sq. yds. 2-course conc.; Washington Ave. Pav'g. Dist.— 54,000 sq. yds. 2-course conc.; 20th St. Pav'g. Dist.,—3,500 sq. yds. creo. wood blks.; also 88,000 sq. ft. concrete walks. Brooklyn, Illinois, will lay 33,000 sq. ft. concrete walks. Edmund Hall, City Engr., Granity City.

Ill., Rockford—Pub. Engr. Hand has prepared est. of cost of paving Ridgewood Rd.—Cosper avenue to Greenmount street; Greenmount street—Ridgewood road to Longwood streets, with conc., at about $19,600.

Ill., Springfield—Among Impvts. decided upon by City Comn., are the following: Pave Capitol Ave., with creo. blks., from Second to Tenth Sts.; widen thoroughfare leading to state house 8 ft. betw. 2nd and 8th Sts.; Pave a total of 70 blocks in bus. dist. with creo. blks.; widening sts. which bound court house; pave Monroe street—Spring to 10th Sts.

Ill., Taylorville — City preparing plans for paving abt. 40,000 sq. yds. one-course reinf. conc. pavement, with integral curbs. Est. cost abt. $90,000. Work will begin soon. J. W. Dappert, City Engr.

Ind., Terre Haute—Board of Public Works plans improving streets as follows: Resurfacing Wabash Ave., betw. Wabash avenue brdg. & 13th street; resurfacing Wabash avenue—13th to 19th streets; paving 16th street—Crawford to College avenue; paving Ohio betw. 2nd and Water streets; paving First street—Ohio to Cherry streets; resurfacing of Cherry—2nd to 9th streets; N. 25th street—4th to 6th avenues.

Ind., Wabash—Reconstruction and paving of National road from state line to Terre Haute, will be first road-bldg. project to be undertaken this summer under comb. supervision of newly created State Hwy. Comn. and Fed. government.

Ia., Emmetsburg—City beginning proceeding with view to paving abt. 70 blocks of streets. Palo Alto County expects to gravel about 60 miles on county road system.

Ia., Marengo—City Council has decided to construct 80 blocks of paving, in response to the numerous paving petitions filed during the past few weeks.

Ky., Benton—Marshall County Commrs have $64,000 available to construct 30 miles of Jefferson Davis Hwy.

Kans., Ft. Scott—About 200 miles hard-surfaced roads will be built in county. Est. cost abt. $1,600,000. C. R. Fisher, City Engr.

La., Natchitoches—Natchitoches Parish Police Jury will construct 18 miles Jefferson Hwy.,—Robeline through Natchitoches to Grand Ecore—$140,000 available. Constr. under supervision State Hwy. Dept., Baton Rouge.

La., New Orleans—State Hwy. Commission—Duncan Buie, Engr., is preparing plans for construction of 50 mile water bound macadam and gravel road also bridges over swaps.

Maine, Bangor—State's share of postoffice appropriation bill is $482,000 and in order to receive this amt. the state must appropriate equal sum. Bill to appropriate such an amount is now before the legislature. Exact amount to be expended will be $964,000. One of the first jobs to be undertaken will be the constr. of a trunk line hwy. betw. Portland and Auburn via Poland Springs.

Md., Frederick—Frederick Co. Commrs. considering expendt. of $233,842 to rebuild 5½ miles of Buckeystown Pike and 1.8 miles of road from Emmitsburg to Bridgeport. $116,921 State aid.

Mass., Holyoke—$160,000 appropriated for road building program. In addition to this Mayor's Advisory Board will recommend an additional loan of about $65,000.

Mass., Springfield—Town of Tittsfield plans to start preliminary work at once on $200,000 paving program which has been adopted for this year.

Mich., Adrian—City will issue $125,000 bonds for new paving projects.

Mich., Benton Harbor—City considering paving program which provides for re-paving practically entire down-town business section. The asphalt paving will be taken up and concrete foundation laid.

Miss. — (Greenville) Washington Co., voted $1,225,000 bonds to constr. 140 miles of concrete roads; $800,000 available from previous bond issue; (Charleston) Tallahatchie County voted $100,000 bonds to constr. Jefferson Davis Hwy. Beats 1, 2 and 3.

Mo., Liberty—Clay County Commrs. will proceed with plans for construction of 202 miles of hard-surfaced roads, to include road from North Kansas City to Excelsior Springs, 24 miles; also county's link of Jefferson Hwy. from No. Kansas City along west line of county through Smithville, 22 mi.; $1,250,000 bond issue previously authorized.

Mo., St. Louis—Plans for widening of Twelfth St.—Park avenue to Florisant avenue, practically completed by Harland Bartholomew, Engr. of City Plan Comn. Proposed boulevard will be 80 ft. wide and will cost about $1,800,000. To eliminate necessity of tearing down portions of large bldgs. affected by the impvt., the bldgs. at Twelfth street & Washington avenue will be arcaded. Impvt. of so. sect. of the blvd., from Chouteau to Park avenue will be undertaken first. This will cost abt. $240,000.

N. J., Elizabeth—Union County's impvt. program for 1919 is as follows: $120,000 for new road construction under State Aid Laws; $175,000 for maintenance, repairs and upkeep of county road system; $200,000 for new bridge construction—(last named sum being the approximate figure). J. L. Bauer, County Engr.

N. J., Trenton—City plans to construct following improvements during 1919: Market St.—Broad to Clay streets—2,350 sq. yds. asph., 815 sq. yds. granite blk.; 120 sq. yds. conc. gutter; 215 lin. ft. new b.s. curb; 765 lin. ft. curb reset; 20 lin. ft. old header and 50 lin. ft. circular curb. Hamilton Ave.—Broad to Clinton—5,360 sq. yds. asph., 270 sq. yds. gutter; 1,650 lin. ft. curb reset; 200 lin. ft. old headers; 125 lin. ft. new B. S. curb; 60 lin. ft. granite circ. curb; 40 lin. ft. conc. cic. curb; Greenwood Ave.—Chambers St. to city line—13,750 sq. yds. asph., 710 sq. yds. gutter; 830 lin. ft. curb reset; 410 lin. ft. old header; 125 lin. ft. conc curb; 25 lin. ft new B. S. curb; 25 lin. ft. circ. curb; Lafayette St.—Willow to Warren Sts.—1,500 sq. yds. asph., 210 sq. yds. gutter; 550 lin. ft. curb reset; 565 lin. ft. new conc. curb; 65 lin. ft. new B. S. curb; 50 lin. ft. circ. curb and 20 lin. ft. old header reset; Montgomery St.—Academy to Perry St.—804 sq. yds. asph., 530 lin. ft. curb reset; 10 lin. ft. new B. S. curb and 35 lin. ft. circ. curb; Perry St.—(across former raceway of Trenton Water Power Co.) 165 sq. yds. asph.; LaClede Ave.—State to Sanhican Creek—875 sq. yds. asph.; 125 sq. yds. gutter; 385 lin. ft. conc. curb and 25 lin. ft. old header: Greenwood Ave., resurfacing —clinton Ave., to Monmouth St., 9,012 sq. yds. asph., 50 lin. ft. new B. S. curb and 100 lin. ft. circular conc. curb.

N. H., Concord—With increased Fed. Aid appropriation this state will have available $1,500,000 for constr. work this season. There remains to be built on the cross state road system abt. 300 miles of roadway, a greater part of which will be of gravel constr. F. E. Everett, Commr.

N. Y., No. Tonawanda—Petitions being circulated for about 30,000 sq. yds. of paving. Outlook favorable and bids may be asked in abt. 2 months' time. Carl L. Oelkers, City Engr.

N. C., Jacksonville — Onslow County Commrs. will issue $250,000 bonds for hwy. construction: $750,000 State & Fed. aid available, making a total of $1,000,000 for road work.

Ohio, Alliance—City planning 31,000 sq. yds. paving at approx. cost of $145,000. H. E. Anderson, City Engr.

Ohio, Defiance—Another addition will be made to the city program this summer by including nearly a mile of paving on E. Second street. This will make city's paving expendt. amt. to $125,000.

Ohio, Greenville—Mr. Wade of State Hwy. Dept., announces that surveyors will be put to work preparing specfs. for improvements on highways in Darke County and construction will begin just as soon as the improvements can be advertised. Inter-county program provides for hard surf. road from Brock to No. Star—an exten. of the Lincoln Hwy.—branch road from Dawn to Versailles and stretch of conc. roadway which extends from so. corp. line to Greenville to Jaysville will be extended to Arcanum.

O., New Lexington—State appropriation of $29,000 has been approved for repair and maint. of improved rds. in Perry County. Money will be expended as follows: Resurfacing pike at Moxahala, $3,100; resurfacing Roseville-Crooksville pike, $2,600; resurfacing pike east of New Lexington, $2,000; resurfacing New Lexington-Shawnee road, $4,700; repairing Shawnee-New Lexington road, $4,700; repair'g Shawnee-New Straitsville rd., $1,300; resurfacing Thornville road to Licking line, $3,400; resurfacing Somerset-Thornville road, $5,600; repairing cracks, ruts, etc., New Lexington-Somerset brick road, $2,500, etc.

Ohio, Painesville—State Hwy. Comn. has notified county Commrs., that the North Ridge Main market road betw. here and Geneva—12 miles—will be paved with brick. 5-in. conc. base and 5-in brick will be used.

Ohio, Wapakoneta—Resolution adopted by Commrs. of Auglaize County authorizing bond issue of $142,000 to take care of county, twp. and landowners' share of expense of completing paving program betw. here and St. Marys—about 6½ miles. Total cost of impvt. is $234,000, of which $92,000 will be paid by state and federal government.

Ohio, Willoughby—Following work either under way or being considered by village for this season: Completion of Waldamere Ave., brk. pavement, 5,000 yds.; constr. of brk pavement in River, Center and Wilson avenue 14,000 yds. Abt. 1,000 yds. brk. pavement will be built within village under Co. and State supervision. Chas. D. Clark, Village Engr.

Ohio, Zanesville—$1,101,929 will be expended in state for road bldg., this fall and summer; in Muskingum county alone a half million dollars will be spent on 3 road bldg. projects.

Okla., Newkirk—City is planning for pavement of 50 blocks of its principal streets during present year. H. G. Olmstead, City Engr.

Ore., Grangeville—North and South Hwy. link betw. here and New Meadows will be rushed to completion this year. Idaho County received $283,000 for the North and South highway and will also receive $48,000 state aid for Lewis & Clark Hwy.

S. C., Union—Every Twp. in Union County has voted $150,000 bonds for bldg. permanent highways; total sum being $1,175,000.

R. I., Providence—City plans to expend about $400,000 for repairs and maintenance of streets. This sum has been apportioned by Pub. Wks. Dept., as necessary for street impvts.

S. C. York—City will expend $100,000 to pave 4 to 5 miles on Congress, Liberty and other street, conc., asphalt and other materials.

Tex., Austin—Rockwall County will have $1,000,000 available for road construction. Their bond issue of $800,000 has been augmented by $200,000 from State Hwy. Comn.

Texas; Groesbeck—Limestone County: District No. 4 has voted $250,000 bonds for road improvements: Dist. No. 10 $65,000 and Dist. No. 12, $60,000.

Tex., Hillsboro—$250,000 bonds voted by Hill County for construction roads in Hubbard Roads Dist. No. 3.

Tex., Kaufman—$1,450,000 bonds voted by Kaufman County for road construction; Commrs. Precinct. $750,000; Justice Precinct No. 5, $300,000; Justice Precinct No. 7, $400,000.

Tex., San Antonio—Approximately $4,000,000 Federal Aid for road construction allotted by State Highway Comn.

Va., Norfolk—$750,000 bonds appropriated by City Council for paving on Boush, Plume, Tazewell, Dunkere, 24th and 17th Sts., and Fairfax, Pembroke and Colley Aves.

Wn., Aberdeen—Bids to be asked immediately for paving 7 blks. of First Street. This will be first paving jobs started by city. Second will probably be paving of 3 blks. on Hume Street.

Wash., Spokane—The State's new hwy. paving program will begin about June 1st, when the Highway Comn. will open bids on 79 miles of hard surface improvements, roughly estimated to cost $1,975,000.

W. Va., Buckhannon—Upshur County, Buckhannon District having surveys made by J. C. West, County Road Engr., preliminary to impvt. of roads. $180,000 bonds previously voted.

Wis., Beloit—Council has ordered 10 miles of city's streets paved during this year. Work will start as soon as possible.

SEWERAGE AND SEWAGE TREAT-TREATMENT

Ariz., Somerton—Olmsted & Gillelen, Consult. Engrs., Hollingsworth Bldg., Los Angeles, retained by City to prepare plans for sewer system for this city. Project will cost approx. $30,000.

Ark., Hot Springs—Sewer Improvement District No. 40 will expend $4,200 for laying 6-in. pipes. Sewer District No. 42 will expend $9,000 for laying 6 and 8-inch pipe. Cleveland Smith, City Engr.

Ark., Paragould—City may expend $5,500 on sewer construction this season. Guy Adams, City Engr.

Ark., Springdale—City will construct sewer system. Est. cost $50,000. L. Winters, Engr., 700 S. 20th St., Ft. Smith, Ark.

Cal., San Francisco — City Engr. O'Shaughnessy has recommended to Board of Supervisors, sewer construction estimated at $50,000.

Cal., Los Angeles—Resolution adopted by City Council to construct cement pipe sanitary sewer in Melrose Hill and Marathon street and also in Phillips Way and other streets.

Cal., Fresno—$200,000 bonds voted in north Fresno sanitary sewer district. City Engr., Mr. Murray.

Ct., Ansonia—City plans expendt. of about $10,000 on storm and sanitary sewers this season. V. B. Clark, City Engr.

Ct., Shelton—City has appropriated $9,000 for sanitary sewers and has let contracts covering most of the appropriation. V. B. Clark, Engr.

Fla., Key West—City considering installation salt water sewer system. Chas. W. Chase, Secy. Chamber of Commerce.

Fla., Pensacola—City plans to sell $75,000 bonds to install sanitary sewer system engineer now surveying city in conjunction with Cty Engr. Fred Renz. Work will be tem; total cost, $95,000. Abt. $20,000 now available.

Idaho, Boise City — City considering constr. of new sewer outlet to cost from $16,000 to $25,000, according to plant selected. C. C. Stevenson, Engr.

Ill., Batavia—Ord. passed providing for $140,000 sewer system for the east side.

Ill., Chicago—Pres. Flaherty, Board of Local Impvts., has advised that since sanitary district has agreed to build its new intercepting sewer in accord. with the city's wishes, some agreement will be reached in time for starting the intercepting sewer. City must rebuild all on acct. of rapid growth of city.

Ill., Streator—City has decided to lay out anew practically her entire sewer system at est. cost of $300,000. Chicago sanitary with City Engr. Fred Renz. Work will begin in August if engineers can get it planned by that time and Council can obtain the contractors.

Ind., Indianapolis—Chas. H. Hurd, has entered into contract with Board Sanitary Comnrs., as consulting & supervising engineer, in charge of con. of proposed sewage disp. plant at Sellers Farm. Est. cost of work $2,000,000. Mr. Hurd will have complete supervision of drawing up of plans and carrying out of actual constr. of plant.

Iowa, Emmetsburg—City will construct storm sewers within or to proide for paved district consisting of about 70 blocks. T. R. Martin, Co. Engr.

Iowa, Farragut—Engrs. Grupe & Walter, 204 Bee Bldg., Omaha, making surveys for sewerage system.

Iowa, Iowa City—City may expend abt. $20,000 for sewer construction this season. Stanley M. Hands, City Engr.

Ia., Ft. Madison—City has now 3 options on three city blocks for purpose of bldg. proposed sanitary sewer system, which is greatly desired by all the citizens of Fort Madison.

Ind., Ft. Wayne—Bd. Pub. Wks. approved resolutions for 3 sewers; 12-in. sewer along Wheeler street, a 12, 15 and 18-in. sewer betw. Pittsburg St. and the Penn., and on Penn. Street; also a 12, 15 and 18 and 24-in. sewer betw. Maumee and Winter streets.

Kans., Cottonwood Falls—Ord. passed authorizing and directing W. B. Penn, City Clk., to call for bids for constr. of sewers

and sewage purification plant. Sep. bids will be asked on following: (a) Furnishing labor and materials for constr. of sewers within city; (b) furnishing labor and material for constr. of sewers in city as designated by Sec. 3; also furnishing labor & material for constr. of sewers and sewage purification plant as designated by Ord. 380.

Kans., Salina—City will construct one-half mile of sewers this season. It is also considering extending outfall sewer two miles. P. G. Wakenhut, Engr.

La., Alexandria—City considering expendt. of $500,000 for extension of sewer and water sys., also impvt. of streets.

Me., Norway—$5,000 voted for sewer system to drain Cottage St.,—Main to Beal street; also Beal street to Bird Brook. Geo. F. Hathaway, Chrmn. Board of Selectmen.

Mass., Cambridge—City will expend $30,000 for construction of sewers for sanitary purposes and for sewage disposal.

Mass., Fall River—Recommendations from the Comn. on Sewers for sewer construction to cost $60,000 have been adopted.

Mass., Lawrence—Council has voted to adopt an order for advertising of a loan for $40,000 for sewer work and allow the constr. of all sewers now petitioned for. City Engr. A. D. Marble estimates work as follows: Butler street sewer, Milton to Ames streets, $19,200; Andover street, 1,000 ft. westerly to Eaton street, $5,000; Plymouth Mills sewer, $6,000 plus from Lawrence Gas Co.; Pleasant court, $2,000 and So. Broadway culvert at Gilbert street, $2,825.

Mass., Millis—Sewage disposal plant will be built here at estimated cost of $60,000. E. Worthington, Engr., in charge, Dedham, Mass.

Mass., Quincy—Included in budget for 1919, passed by Council, is $97,040 for sewers.

Mass., Reading—Comn. on metropolitan affairs has plan that provides for system that will connect with Stoneham end of north Metropolitan sewer. Eventually it is planned to tunnel Bear Hill and carry the sewerage under the hill. Until this is done, however, it is proposed to locate a pumping station on the Reading side of the hill. Est. cost of project $100,000.

Mich., Pontiac—Estimate filed for constr. of sewer on Haddock street and Perry street from Chamberlain street, $4,971.

Mich., Pontiac—City has purchased 5 acres of ground to be used as site for new sewage disposal plant.

Minn., Duluth—Council has ordered construction of approx. $40,000 worth of sanitary sewer work. J. A. Farrell, Commr. of Works.

Minn., St. James—$30,000 voted by City for sewer & light systems.

Neb., Nebraska City—Engrs. Grupe & Walter, 204 Bee Bldg., Omaha, making surveys for sewerage system. When plan has been completed, will be submitted to voters for bond issue; 3,000 ft. 24-in. sewer pipe and 5,000 ft. 30-in. pipe.

N. Y., Brooklyn—Construction of a big $6,000,000 sewer from L. I. City to Corona is being considered. Proposed sewer constr. will be largest both in size and cost ever undertaken in city of New York. Main trunk sewer which will outlet into Flushing Bay through properly constructed screening plant, will cost, according to present estimates $6,000,000.

N. Y. Utica—J. Kemper, City Engr., has prepared plans for sewerage system and sewage disposal plant. Proj. involves 8-12 in. sewers in No. Genesee, Riverside, Trenton, Walker and Herkimer Rds.; also Auert Ave.; also 1,860 ft. 15-18 in. main sewer from Genesee street across private right-of-way to disp. plant at north side of barge canal, sludge tanks at either end of main tank.

N. J. Lyndhurst—Town Council plans to construct surface-water sewer in Valleybrook Ave. Abt. $20,000.

N. C., Greensboro—Plans prepared for constr. of one mile of sewers and 1½ miles of water mains. M. M. Boyles, City Engr.

Ohio, Alliance—City will expend abt. $25,000 for sanitary and storm sewers during 1919. H. E. Anderson, City Engr.

Ohio, Bexley—Village considering installation of storm sewer system running north and south through village at est. cost of $90,000; sanitary sewer also contemplated.

Ohio, Chillicothe—City will construct sanitay and storm sewers in Western Avenue this summer. Council passed Resolution to construct 8-in. sanitary sewer in Cherry Street—intersect. of Mill & Arch streets; work to begin soon. City Engr. Henry M. Redd, also instructed to prepare plans and specfs. for sanitary sewers in Water street—Paint street to 1st alley east on Watts street betw. 5th and Main streets.

Ohio, Findlay—In order to comply with the order of the State Board of Health, approved by Gov. Cox and the atty. general, this City will be required to provide adequate sewage treatment plant within 16 mos., to stop pollution of the Blanchard River.

O., Salem—City will construct two new filter beds at City Sewage Disp. Plant at cost of $30,000. B. M. French, City Engr.

Ohio, Toledo—City will receive bids in May for bldg. Creek Sewer 10 miles long. Work involves 6 miles 48-72 in. sewer pipe. Bids will be received on all types of construction. H. C. McClure, 229 Valentine Bldg., Toledo, Engr.

Okla., Frederick—Plans prepared by City Engr., C. E. Ensminger, approved by Council, for constr. of new sanitary sewer system to cost approx. $150,000. Nearly 10 miles of sewers contemplated in system. All lateral pipes will be 8-in. in diam. There will be approx. 2 miles of mains and 8 miles of laterals.

Ore., No. Bend—Plans & specfs. for sewer impvts. in Porter Hill residence district of city, approved and adopted at meeting of city council. Approx. cost $30,000. Total street impvts. in city will exceed $100,000.

Ore., Portland—Immediate constr. of trunk sewer system in Rose City Park and Bellcrest additions, made possible by adoption of report filed with City Council. Approx. cost of sewer $360,000.

Ore., Portland—Resolutions will be introduced in Council authorizing construction of trunk sewer from E. 33rd to E. 42nd Sts., to serve an area of 321 acres bounded by these streets as well as Francis Ave. and Powell Valley road.

R. I., Providence—City will expend $218,375 for construction and maintenance of sewers.

S. D., Aberdeen—Preliminary plans prepared for bldg. storm sewers. Bonds for $350,000 will be voted for the work. F. Le Cocq, City Engr.; Burns & McDonnell, Interstate Bldg., Kans. City, Mo., Consulting Engrs.

N. D., Twin Brook—Plans being made for sewer system. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul.

Tex., Dallas—Storm sewers will be built over Mill Creek from City Park at Ervay street on Jefferson Avenue from 10th to Marsalia and on Fifth St. and Beckley Avenue. Mill Creek sewer at Ervay street will cost approx. $35,000.

Tex., Fort Worth—City voted $725,000 bonds for constructing sewage disposal plant; $325,000 to extend and improve sanitary sewer system and $100,000 to extend and improve storm sewer system.

Utah, Ogden—City must take immediate steps to change outlet of sewer sys. If bond election, in which provision is made for funds for impvt. of sewer system, fails, State Health Board will take action.

Utah, Ogden—City Comnrs. have agreed to amend Ord. being published regarding bond issue, increasing amt. from $500,000 to $825,000; the additional $325,000 to be used for constr. of an extension of the Third Ward sewer along Wall avenue and west to the Webster river.

Va., Lynchburg—Following out suggestions made by Mayor, Councilman Turner introduced resolution to appropriate $20,000 to be used in sewer constr.

Wash., Camas—City Council adopted resolutions of intention to construct new trunk line sewer system in city. Est. cost $27,000. Resolutions also adopted for paving Oneonta street—First to city limits and Beeson St.

Wis., Chippewa Falls—Council has ordered sewers as follows: (a) E. Columbia Street; (b) State street, (c) Grove St., (d) Short St., (e) Wells St. Bids will be asked in May.

Wis., Cumberland—Plans being made for sanitary sewer and 10 blks. of paving. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Consult. Engr.
of an Imhoff disp. plant for sewerage system, laying of approx. 2,200 ft. 12 in. vitr. pipe line to plant, etc.

WATER SUPPLY AND PURIFICATION

Ariz., Phoenix—City Engr. L. B. Hitchcock instructed to make estimate of cost of piping water from Verde river at point 40 miles from here and constructing storage reservoir on the mountains adjacent to the city to provide supply of soft water for the municipality.

Ariz., Somerton—Olmsted & Gillelen, Consult. Engrs., Hollingsworth Bldg., Los Angeles, Cal., retained by City to prepare plans for new municipal water works system. Approx. cost $70,000.

Cal., Hermosa Beach—City Trustees have instructed City Clk. Benj. Brown to communicate with engineer firms regarding plans for proposed municipal water system for town. Adequate plant will cost approx. $100,000.

Cal., Sacramento—Election called to vote on proposal to issue bonds for constr. of new filtr. plant to cost, with machinery and equipt., $1,200,000; also an incinerator plant, $143,000. Will also vote on constr. of wharf and warehouse, $160,000. If bonds are voted considerable electrical and mechanical equipt. including motors, hoisting and conveying machinery will be required. Work will be in charge of City Engineering Dept.

Cal., Santa Barbara—Bd. of Water Commrs. has recommended a $100,000 bond issue. $40,000 is needed to complete the Gibraltar dam under the present contract and $54,000 for the construction of pipe lines. 9,000 ft. 24-in. pipe will be required to deliver the water from Gibraltar dam to the Mission reservoir and the use of redwood continuous stave pipe has been recommended for this line.

Fla., Leesburg—$30,000 bonds voted to construct water wks. J. C. Lee, Acting Mayor.

Fla., Sarasota—City has issued $45,000 bonds for water and sewer constr. Paul Thompson, City Clk.

Ga., Swainsboro—$50,000 bonds voted by City to construct water wks. and sewer system.

Ind., No. Judson—Business men of this town have appointed special committee to report on cost of construction of water works system with view to install plant this summer.

Kans., Ft. Scott—City will construct impounding dam on Marmaton River for water works. Est. cost $70,000. C. R. Fisher, Engr.

La., Alexandria—City considering expendt. of $500,000 for extension of water and sewer system; also improving streets, etc.

La., Baton Rouge—City will install 5,000,000-gal. pump water plant bldg. concrete foundation; expending $30,000 for improvements to furnish ample water supply.

La., Glenmora—City considering construction of water works. Xavier A. Kramer, Engr., Magnolia.

La., Shreveport—City plans impvts. to water works. Chester & Fleming, Engrs. have made survey and submitted report recommending Cross Lake as source of supply and enlargement of water plant; suggests 3 plans—erect. of pumping plant with exclusive supply from Cross Lake, $831,565; rebldg. present plant with 3 courses of supply available, $727,950; duplicate of second plant with 2 sources supply avail., $441,910.

Mich., Bay City—City has revised plans and estimates prepared for improving water works system. Abt. $1,000,000 bonds will be voted for project. R. C. Dawson, W. W. Supt.; Burns & McDonnell, 400 Interstate Bldg., Kans. City, Mo., Engrs.

Mich., Belding—City will repair water works plant; also sink one 6-in. well and probably two. Will use glazed tile pipe to connect wells to receiving basin. P. A. Frederick, Supt. Belding.

Mich., Detroit—R. Winthrop Pratt, Consult. Engr., has recommended to Bd. Water Commrs. a filtration plant costing $5,800,000.

Mich., Port Huron—City plans to lay 10-in. water main (cast iron) in Connor street—St. Clair River to 32nd Street. Abt. $32,000. E. Whitmore, City Engr.

Minn., Brainerd—$300,000 water works bonds voted at recent election. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Minn., Consult. Engr. Bids soon.

Minn., Frazee—Village has voted $20,000 bonds for installation of water works system.

Minn., Pipestone—Council has instructed above named engineer (L. P. Wolff) to prepare final plans for proposed water wks. impvts. $77,000.

Minn., Montevideo—At recent election $45,000 bonds were voted for water works. B. O. Bonn, City Clk.

Miss., Wiggins—City will issue $12,000 bonds to purchase and improve water works.

Mo., Plattsburg—City Atty. instructed to prepare Ord. calling for elec. vote on bonds for construction of water works system. Est. cost of sys., $70,000. Mr. Harper, City Engr., proposes large dam to catch the water and have it purified with gravity filtr. plants. People anxious to have water works system.

N. Y., Buffalo—Board of Public Works contemplates laying 15,000 ft. 6-in. water main throughout city at cost of $150,000; also install new equipt. and alter pumping

station on Mass. Ave., at $150,000. A. W. Kreinheder, Comnr.

N. Y., Mechanicsville—City having surveys made and plans prep. for new water supply system. J. R. Smith, Commr. Public Wks.

N. Y., Newark—$280,000 bonds voted by city to build gravity water supply system. Wk. includes pipe line involving 1,750 tons c.i. pipe; 1,000,000-gal. rapid sand filtr. plant, earth dam and dike, etc. J. P. Wells, Cutler Bldg., Rochester, Consult. Engr.

Ohio, Alliance—City contemplates improving water works; also extension of system. Est. cost abt. $55,000. H. E. Anderson, City Engr.

Ohio, Canton—City Water Commission will suggest to Council, legislation authorizing $1,275,000 bond issue to carry out water works improvements.

Ohio, Mansfield—$11,700 bonds for constr. of water mains in Syndicate Addition and elsewhere authorized.

Okla., Henryetta—City plans to rebuild water works. Plans call for rebldg. present system to double capy. Est. cost $350,000. Money will be raised by bond

Okla., Miami—Southwestern Light & Transport Co., 404 Commerce Bldg., now ready to construct water power on Grand River; northeastern Oklahoma; 7 dams, 15,000 H. P. each; plan auxiliary plant will hold peak load in low water or flood; need steam turbine; 10,000 H. P. within 60 days.

Okla., Picher—City plans to vote on $250,000 bonds for purpose of constructing water and sewer systems.

Ore., Astoria—City Council has enacted laws providing for installation of water system which will include laying of abt. 4,000 ft. of distributing mains.

Pa., Dubois—Water Commrs. have approved plans for addition to water works system. About $100,000.

R. I., Providence—Board of Aldermen passed resolution authorizing hiring of $500,000 with which to finance more work to be done upon city's water supply in Scituate. Abt. $25,000 of this amt. is needed for road work; balance will be used in continuing work on main dam at Kent.

S. D., Midland—Petition presented to Town Bd., containing name of nearly every property owner, requests Bd. to submit question of water wks. system at special election. Plan is to sink artesian well, conducting the water through a sprayed cooling sys. to large elevated tank from which it will be carried through mains to bus. and residence districts. Station will be located on a natural elevation and it is estimated water will have pressure of 120 pounds.

Tenn., Howell—Howell Water Co., organized. Will construct reinf. conc. reservoir; capy. 50,000 gals. Abt. $4,000. E. L. Parks, Engr., Fayetteville, Tenn.

Tex., Alpine—City having plans prepared for water works and sewer system. C. P. Bartlett, Engr., Moore Bldg., San Antonio, Tex.

Tex., Houston—Council has authorized $100,000 bond issue to improve water plant, extend mains and drill wells.

Tex., Mt. Vernon—Council has ordered issuance of bonds & warrants to amt. of $13,5000 for improving water works plant. Addtl. storage reservoirs are to be constructed and modern filtr. plant put in.

Tex., Oak Forest—Houston-Guadalupe Water Power Co., 601 Foster Bldg., Houston, will construct conc. dam 110 ft. long, 15 ft. high; also power house; 500 h.p. hydro-electric installation; expend $500,000.

Tex., San Angelo—City voted $500,000 bonds to erect water & electric light plant or to purch. Interstate Electric Corp's. Plant.

Va., Petersburg—City considering $200,000 bonds to lay water mains in connection with street paving. R. D. Budd, City Engr.

Wash., Seattle—Supt. Walter L. B. Youngs anticipates early start in spring on improvements to city's water supply sys. In addition to raising of level of Swan Lake 20 ft. and using that body of water as reserve reservoir, other important develop. projects are contemplated. Swan Lake lies 3.8 mi. below point where city water is diverted from Cedar River; plan is to turn water in at upper end of lake where it will enter pipes through a tunnel 2 mi. below lake. Tunnell will be 8 ft. in diam. and 2 mi. long with capy. of 150,000,000-gals. a day, a third pipe line to city will be built and fourth line may be built from lower end of tunnel. Two years' time will be required to complete the work intended. est. to cost $3,700,000.

Wis., Beloit—Common Council has ordered that water mains be laid on those portions of Dewey avenue, Mill street, Nelson avenue, Prairie avenue, 6th St. and Woodward avenue, included in first paving project.

Wis., Chilton—Plans being prepared for constr. of water and sewer connections, involving 3,000 ft. ¾-in. water connections. Jerry Donahue, Engr., Sheboygan, Wis.

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BRIDGES

Ariz., Phoenix—Legislature has appropriated $20,000 for construction of bridge over Oak creek in Yavapai County near Cornville postoffice.

Fla., Tampa—A bridge over Hillsborough river, at Platt street, on west bank and Carew street on east bank, is proposed by St. Petersburg & Tampa Transportation Co. The interurban company has secured righ-of-way betw. Tampa and St. Petersburg and expects to start work as soon as materials can be obtained. It will be necessary not only to build roadbed and lay tracks, but also to build 6-mile causeway and bridge from Hillsborough Co. shore of old Tampa Bay to Pineallas Co. Est. cost $1,000,000.

Ga., Canton—Cherokee County Commrs. will ask bids to construct two conc. bridges; one 228 ft long and the other 24-ft.; 600 cu. yds. concrete; 36 tons steel; 740 lin. ft. concrete piling and 576 lin. ft. wooden piling Johnson & Morgan, Engrs., 500 Forsyth Bldg., Atlanta, Ga.

Ida., Boise—4 steel and concrete bridges will be constructed this season. Two of these will be built over Middleton canal near Star and will be 30- ft. long; a 20-ft. brdg. will be placed of the Farmers Union ditch near Eagle; remaining brdg. now being built.

Idaho, Pocatello—City, acting upon a numerously signed petition, is considering erection of a $14,000 steel bridge over Portneuf river on West Whitman street.

Ill., Metropolis—County Commrs. approved final plans for 5 new concrete bridges to be built under state aid plan. Bridges located in eastern part of county.

Ill., Sheridan—New bridges will be constructed over Rox River. Est. cost $25,000. Cost of bridge will be covered by Twps. benefited.

Ind., Ft. Wayne—County Commrs. have ordered plans for constr. of bridge across St. Marys river in Swinney Pk.

Ia., Cedar Rapids—Bids abt. July 15th for bridge on First Ave. J. L. Storey, City Clk. Six 100-ft. span conc. brdg. $250,000.

Ia., Decorah—Winneshiek County, owing to recent flood, will expend abt. $50,000 to $75,000 for bridge construction this year. Frank U. Arneson, County Engr.

Mass., N. Attleboro—Petition of Norfolk County Commrs. to borrow $75,000 additional funds for constr. of bridge over Monatiquot River at Braintree admitted yesterday under suspension of the rules.

Mich., Adrian—Adrian will issue $20,000 for purpose of bldg. new brdg. over River Raisin at Maumee street crossing.

Minn., Long Prairie—Board of Commissioners plan to build 4 reinf. conc. and steel bridges; one to have 70-ft. span. Abt. $15,000. E. M. Berg, Co. Aud.

Minn., Marshall—Three highway bridges will be built here this season. Bill before legislature asking for aid. O. H. Sterk, Lyon Co. Surveyor.

Minn., Stewartville—Town has voted in favor of new $20,000 bridge across Root river on No. Main Street. Bridge will be 180 ft. long and will be of cement construction.

Ohio, Canton—County Commrs. considering plans for conc. bridge over Tuscarawas river at Navarre. Est. cost $18,000. Bridge will consist of 2 spans 70-ft. in length.

O., Fremont—Resolutions passed by Co. Commrs. to build 2 brdgs.; the Peter Kirsch bridge, Washington Twp., and Huber saw mill bridge, Green Crk. Twp.

Okla., Madill—Marshall County Commrs., Madill, and Grayson County Commrs., Sherman, Texas, contemplate bldg. steel bridge over Red River on Preston Road. Est. cost $100,000.

Tenn., Nashville—$250,000 bonds voted by City for viaduct impvts. J. D. Dashiell, Secy. Bd. of Commrs.

Tex., Ballinger—Highway Commission has approved plans and Commissioners Court preparing to receive bids for constr. of $50,000 concrete bridge or viaduct spanning Colorado River at this place. State Hwy. Comn. has appropriated $37,000 and county gets remainder of $50,000 from bond issue recently voted.

Utah, Salt Lake City—Plans for constr. of 7 conc. bridges on south State Street betw. state capitol and point of the mountain, have been completed by C. B. Fischer, State Bridge Engr.

Wn., Walla Walla—$230,000 bonds voted to construct toll brdg. across River to connect Walla and Franklin Counties.

DRAINAGE AND IRRIGATION

Ariz., Phoenix—New drainage district in Buckeye valley comprises 16,000 acres. If vote is favorable, $150,000 bonds will be issued for construction of drainage system; canal eleven miles long to be constructed.

Minn., Marshall—Town considering the straightening of Redwood river now running through town; ditch to be 40 ft. b, 60 ft. top, 10 ft. deep; 3 r. r. and 3 hwy. brdgs. to be built. A. H. Sterk, City Engr.

STATEMENT OF THE OWNERSHIP MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

OF MUNICIPAL AND COUNTY ENGINEERING published monthly at Indianapolis, Indiana, for April 1, 1919.

State of Indiana, County of Marion, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Alexander P. Fox, who, having been duly sworn according to law, deposes and says that he is the President of MUNICIPAL AND COUNTY ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addressés of the publisher, editor, managing editor, and business manager are:

Publisher, Engineering Publishing Company, Inc., 702 Wulsin Bldg., Indianapolis, Indiana.

Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Managing Editor, Samuel C. Hadden, 538 South Clark St., Chicago, Illinois.

Business Manager, J. H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

2. That the owners are:

Engineering Publishing Company, Inc., 702 Wulsin Bldg., Indianapolis, Indiana.

A. P .Fox, 704 Wulsin Building, Indianapolis, Indiana .

George O. Wildhack, 927 North Meridian Street, Indianapolis, Indiana.

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stocks, bonds, or other securities than as so stated by him.

A. P. FOX, President.

Sworn to and subscribed before me this 1st day of April, 1919.

(Seal) JOHN H. PRITCHARD.

(My commision expires June 18, 1922.)

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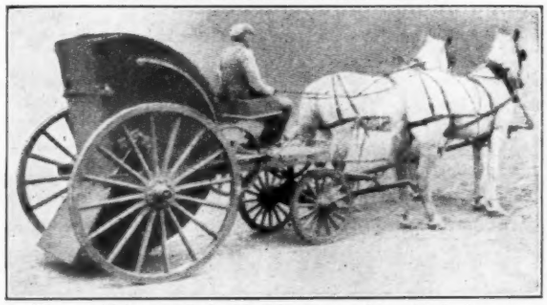

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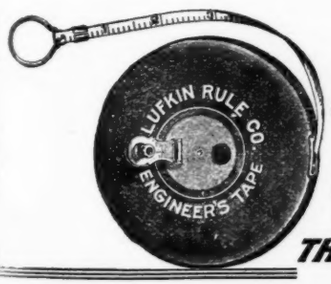

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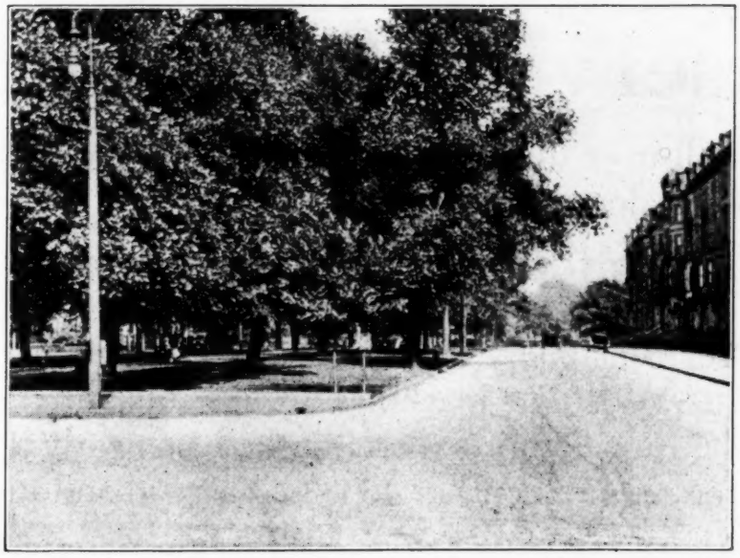

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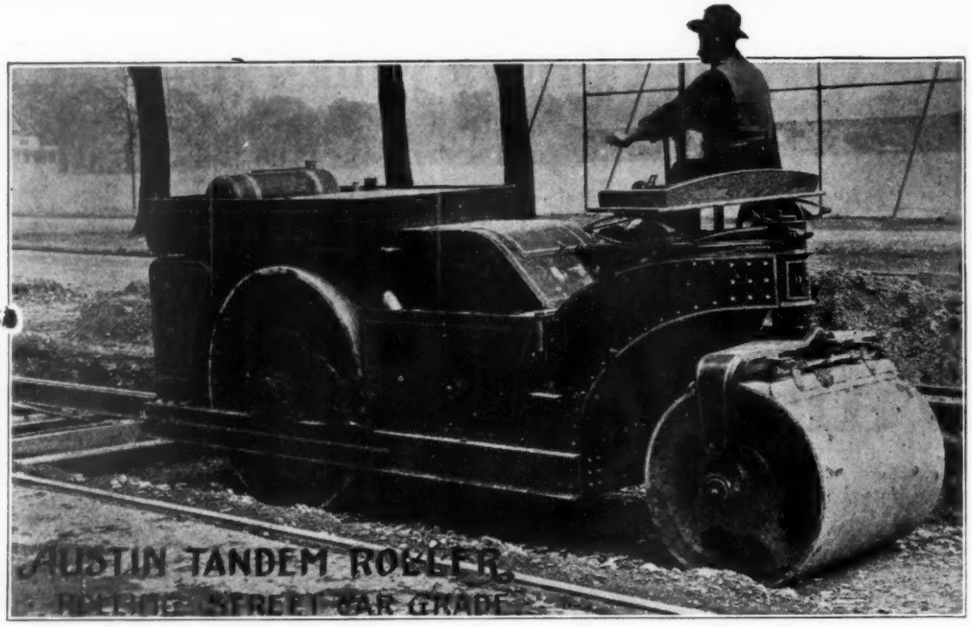

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